Digital Dividend Review: geographic interleaved awards 470 - 550 MHz and 630 - 790 MHz

Consultation on detailed award design

Consultation

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Section 1

Executive summary

Introduction

1.1 This consultation document sets out our proposals for the award of part of the spectrum freed up for new uses by digital switchover (DSO). We call the spectrum made available by DSO the 'digital dividend'. The digital dividend has been the focus of our Digital Dividend Review (DDR) since we launched it in 2005[1].

1.2 There are two distinct categories of spectrum in the digital dividend: the spectrum that by 2012 will be cleared of television transmissions (the cleared spectrum); and capacity available within the 256 MHz of spectrum that will be used to carry the six digital terrestrial television (DTT) multiplexes (the existing DTT multiplexes)[2] after DSO. We are concerned in this document with the second type, which we call the geographic interleaved spectrum. It is so called because for each channel within this spectrum there are geographic areas where not all of the channels will be used for existing DTT and in those areas these unused channels may be used for other services.

1.3 This document is one of three separate consultations we are publishing on implementing the digital dividend awards. Two other consultation documents set out our proposals on the auction for the cleared spectrum[3] (published 6 June 2008) and on the 'beauty contest' for the part of the interleaved spectrum to be administered by a band manager with obligations to Programme Making and Special Events (PMSE) users (to be published later in the summer).

1.4 In our work on the DDR we have found potential demand for digital dividend spectrum for local television. In a statement we published in December 2007 ('the DDR statement')[4] we set out our decisions on the strategic approach we would take to the release of the digital dividend. We considered arguments made to reserve spectrum exclusively for local television but decided against this. Among other things, we considered that this might displace other high value uses for the spectrum and would reduce incentives for efficient spectrum use.

1.5 We have also identified other potential uses for the geographic interleaved spectrum, including new DTT services over a wider area, mobile broadband and PMSE. We

[1] More information about the DDR along with previous DDR publications is available on the Ofcom website at http://www.ofcom.org.uk/radiocomms/ddr/

[2] The existing DTT multiplexes are the six multiplexes which currently make up the digital terrestrial television platform in the UK, commonly referred to as Freeview, comprising Multiplex 1 (operated by the BBC), Multiplex 2 (operated by Digital 3&4 Ltd, jointly controlled by the Channel 3 licensees and Channel 4), Multiplex A (operated by SDN Ltd, controlled by ITV plc), Multiplex B (operated by BBC Free to View Ltd), and Multiplexes C and D (operated by National Grid Wireless Ltd). In the context of DSO, the three multiplexes operated by the BBC (Multiplexes 1 and B) and Digital 3&4 (Multiplex 2) are called the PSB multiplexes, and the three remaining multiplexes (Multiplexes A, C and D) are called the commercial multiplexes. After DSO, at least 98.5 per cent of UK households will be able to receive the three PSB multiplexes. The coverage of the three commercial multiplexes is expected to reach around 90 per cent of households.

[3] *Digital Dividend Review: 550-630 MHz and 790-854 MHz. Consultation on detailed award design*, Ofcom, 6 June 2008, http://www.ofcom.org.uk/consult/condocs/clearedaward/condoc.pdf

[4] *Digital Dividend Review, A statement on our approach to awarding the digital dividend*, Ofcom, 13 December 2007, http://www.ofcom.org.uk/consult/condocs/ddr/statement/statement.pdf

said in the DDR statement that we had decided therefore to award the geographic interleaved spectrum in lots that would be suitable for local TV but would not restrict their use to this service.

1.6 In the DDR statement we proposed that the spectrum to be awarded would be packaged in geographic lots, based on main TV transmission sites serving major towns and cities. We set out an indicative list of 25 possible locations across the UK where we expected that interest would justify offering such lots and/or where local television operators were already licensed to provide an analogue service. We said we would be prepared to consider other locations where there was evidence of demand.

1.7 We also said in the DDR statement that we would award the first set of spectrum lots for those locations where existing restricted television service licence (RTSL) operators need, prior to DSO, sufficient clarity about their options for future spectrum access. These are channels at the Caldbeck, Winter Hill and Wenvoe transmission sites for Carlisle, Manchester and Cardiff, respectively.

This document

1.8 The geographic interleaved spectrum that we propose to award can cover a substantial area of the UK. In this document we put forward 81 transmission sites for which we might award spectrum. If used for DTT, depending on the technology employed, they could in aggregate cover around 80 per cent of the UK population.

1.9 Use of the spectrum for new DTT services could impact on existing DTT services after DSO. We have had to consider both the level of protection that existing services should enjoy and the desirability of allowing a reasonable level of coverage for new services. The technical licence conditions we propose for the new licences aim to provide a reasonable balance between maximising the economic value of the spectrum and minimising the potential disruption to reception of existing DTT multiplexes.

1.10 In our studies of these transmission sites we have found that there are channels available that offer a range of options for coverage. There are those that provide good all round geographic coverage over a wide area. Others provide more limited directional coverage but are still potentially commercially significant. We have categorised these respectively as ‘large’ and ‘medium’ spectrum lots in our list of sites for award. At each of the 25 sites we identified in the DDR statement we could offer both categories of lots. At the other candidate sites we propose to offer ‘medium’ or ‘small’ lots (which provide a smaller or more localised coverage area).

1.11 We are proposing spectrum awards designed to meet the needs of different types of potential interested bidders.

- **Phased awards** of ‘medium’ and ‘small’ lots by auction would take place to match the DSO timetable. The first award would be in late 2008 or early 2009 of lots for Caldbeck, Winter Hill and Wenvoe, i.e. sites that cover Carlisle, Manchester and Cardiff where there are existing RTSLs that are subject to DSO by early 2010. There could be further awards of ‘medium’ and ‘small’ lots in early 2010 and another batch in early 2011 ahead of the latter stages of the DSO timetable.

- A **combined award** of ‘large’ lots in the locations identified as being most suitable for aggregation, i.e. using a number of lots together for one service, if

that is what bidders wish to do. This award would take place after the award of the cleared spectrum. The award of the cleared spectrum is currently scheduled to begin in summer 2009. Therefore the combined award of geographic interleaved lots could potentially start in late 2009. It would be designed to facilitate the requirements of those operators wishing to develop services in a number of locations. It would be based on channels at the 25 locations we identified in the DDR statement, possibly with additional locations where there is sufficient evidence of demand. We propose to offer one 8 MHz channel per location, with the frequency at each location chosen in order to maximize possibilities for geographic aggregation.

1.12 We have identified 81 transmission sites and channels that could be included in the phased awards (see Table 6.1). In light of expressions of interest that we are seeking (see paragraphs 6.48-6.54) we will finalise the list before inviting applications to take part in the auctions.

1.13 We have considered which auction formats would be most suitable for the awards. Our proposals are:

- for the phased awards, a single unit ascending bid auction for each lot, i.e. each location and its related channel;
- for the combined award, either a combinatorial clock auction or a simultaneous multiple round auction, though we have a preference for the former.

1.14 In this document, we set out the auction process and main rules that we propose for the initial phased awards and invite stakeholders' comments on them. We will take the comments received into account in finalising the award process and the rules. Draft award regulations will set out the rules in full and be subject to a separate, statutory consultation.

1.15 The wireless telegraphy licences that we award following the auctions will contain both technical and non-technical conditions. The technical conditions we propose are designed to protect the existing DTT multiplexes from harmful interference from new services after DSO. Since we see provision of DTT as the most likely use of the spectrum we are proposing to include technical conditions appropriate to DTT as basic technical conditions (see paragraphs 8.8-8.16). These may not be suitable for other new non-DTT services and if, after a licence award, the licensee wishes to provide other services we will consider variation of the technical conditions. Our proposed non-technical conditions cover, among other things, multiplex ownership and interoperability (to apply when the spectrum is being used as a DTT multiplex, see paragraphs 9.7 to 9.24). The spectrum rights conferred by the licences will be fully tradable. The licences will have an indefinite term with an initial period ending in 2026, during which time Ofcom's powers to revoke will be limited.

1.16 It is important that the geographic interleaved award promotes both competition and efficiency in the award and use of the geographic interleaved spectrum. We believe that our overall award process will go a long way towards this. We have also considered whether there is a case for us to go further in terms of putting in place general safeguards or other interventions to secure these goals. We conclude that one general intervention may be appropriate, namely an information provision that may help to facilitate an efficient secondary market. We do not consider that there are any specific issues that require intervention or remedy in respect of the geographic interleaved spectrum.

Summary of proposals

1.17 The table below sets out in summary form our proposals for this award.

Table 1.1 Summary of proposals for the geographic interleaved awards

Available Spectrum	**Our proposals**
Spectrum included in the geographic interleaved awards	The geographic interleaved spectrum is the spectrum that will be available on a geographic basis within the 256 MHz of spectrum (470-550 MHz and 630-806 MHz) that will be used to carry the existing DTT multiplexes after DSO. It is proposed that channels 61 and 62 (790-806 MHz) will be awarded with the cleared spectrum. We propose that the remaining 240 MHz will be awarded by auction on a geographic basis, as detailed in this document.
Timing	**Our proposals**
Timing of spectrum awards	We propose a series of awards: • the initial phased award of 'medium' lots in late 2008 or early 2009 of lots for Caldbeck, Winter Hill and Wenvoe, i.e. sites which cover locations where there are existing RTSL operators that are subject to DSO by early 2010; • a combined award of 'large' lots in the locations identified as being most suitable for aggregation, including the 25 sites identified in the DDR statement (entries 1 to 25 in the list in Table 6.1). This award would take place soon after the award of the cleared spectrum, which is scheduled to begin in summer 2009. • possible phased awards of 'medium' and 'small' lots in early 2010 and in early 2011 ahead of the latter stages of the DSO timetable, subject to evidence of demand. This timing is designed to help those wishing to develop local TV services to arrange funding.
Lots to be included in the awards	**Our proposals**
Lots to be defined by channel and geographic coverage	We propose that packaging of spectrum will be in 8 MHz lots (channels). We propose that the spectrum will be for geographically defined coverage areas. The first award will be of lots for Caldbeck,

	Winter Hill and Wenvoe. We propose that the combined award of 'large' lots will include the indicative list of 25 locations set out in the DDR statement. The lots included in the phased awards will be finalised in light of expressions of interest we receive. This document includes a list of 81 candidate transmission sites and channels that could be included in the phased awards (see Table 6.1). In light of expressions of interest we will finalise the list before inviting applications to take part in the awards in early 2010 and in early 2011. Annex 6 sets out the transmission sites and channels that may be included in each award and the phasing of awards.
Technical licence conditions (TLCs)	**Our proposals**
Type of TLCs	We propose to define the TLCs for the available spectrum in the form of block edge masks suitable for the provision of DTT. Where a licensee wishes to provide a service other than DTT we will consider varying the licence. This may require a TLC in the form of spectrum usage rights (SURs) and a 'protection clause' to protect the existing DTT multiplexes.
Balancing new DTT services with protection of existing DTT services	We propose that new DTT services should protect the best DTT coverage and recognise both where analogue aerials are directed and regional and national ITV boundaries. This is the 'median option' described and analysed in paragraphs 5.30 to 5.52.
Non- technical licence conditions	**Our proposals**
Multiplex ownership and interoperability	We propose to include certain restrictions on ownership in relation to use of geographic interleaved spectrum to operate new DTT multiplexes. These would reflect the similar regime under the Broadcasting Act (for example preventing religious or political bodies from holding licences for this purpose). We propose to facilitate technical interoperability between any new DTT services in geographic interleaved spectrum and existing DTT services.
Licence term	We propose that the licences will have an indefinite term with an initial term ending in 2026. During the initial term we will not have the power to revoke for spectrum management

	reasons. We would have the power to revoke the licence for spectrum management reasons at any time after the initial term, subject to giving the licensee five years notice. The notice may be given during the initial term which could lead to the licence being revoked at the end of the initial term.
Licence fees	The auction will determine the fees payable, subject to a reserve price. After the expiry of the initial term, if a licensee continues to hold its licence, there may be additional charges. In particular, to incentivise efficient use of the spectrum, we presently expect to charge AIP.
Spectrum trading	We propose that all licences in this award will be tradable. All types of trade - partial or total; concurrent or outright - will be permitted.
Non-technical restrictions	We propose that the licences will not contain any restrictions on the use to which the spectrum could be put, other than technical licence conditions.
Auction designs	**Our proposals**
Auction formats	For each stage we propose the following auction formats: • a single unit ascending bid auction for each lot for Caldbeck, Winter Hill and Wenvoe; • a combinatorial clock auction or simultaneous multiple round auction for the award of 'large' lots in the locations identified as being most suitable for aggregation – we express a preference for the former. • a single unit ascending bid auction for each lot in the phased awards of 'medium' and 'small' lots.
Main rules for the ascending bid auction of lots for Caldbeck, Winter Hill and Wenvoe	**Our proposals**
Qualification and activity rules	We are proposing that the nature of the rules and penalties relating to collusion and bidder association should be similar to those that we have put in place for other recent spectrum awards. As such, we would notify each applicant of the names and associates of all other applicants and set a date by which applicants must notify us as to whether any

	members of their bidder group are also associates of another applicant. We would also consider whether any members of one bidder group are also members of another bidder group.
Deposits	We propose to require deposits at a number of points in the process: • Applicants pay an initial deposit on the day designated for the submission of applications. Subject to the outcome of this consultation, we propose to set the level of the initial deposit at £10,000. • Before the auction starts we will require bidders to increase their deposits so that they are at least equal to the reserve price. • During the ascending bid stage we may ask bidders to make additional deposits to cover the amount of their bids.
Reserve price	Each lot available for award will carry a reserve price, below which it will not be sold. We propose to set for each lot a reserve price of £25,000.
Pace of the auction	We propose to retain discretion over the scheduling of primary bid rounds, which includes discretion over the number of rounds per day, together with retaining a level of discretion over round price increases in managing the duration of the auction.
Information policy	There is a range of options for releasing information in the ascending bid stage of the auction. We consider that full transparency would make for an efficient auction, with bidders receiving after each round full information on the bids all other bidders have made.
Payment terms	We propose to issue a licence to the winning bidder on full payment of its licence fee, i.e. the price determined through the auction process or reserve price where applicable.
Unsold licences	If a licence remains unsold at the end of the auction, either through an absence of bids or default, we will choose whatever course of action we consider appropriate at that time in accordance with our statutory duties.

Competition and efficient use of spectrum	Our proposals
'Use it or lose it' conditions	We propose not to impose any 'use it or lose it' conditions.
Roll-out obligations	We propose not to impose any roll-out obligations.
Open access conditions	We propose not to impose any open access conditions.
Information provision	We propose to include a licence condition requiring licensees to provide certain information regarding their use of the spectrum, which we would then publish in order to facilitate spectrum trading.
Spectrum caps	We propose not to impose any spectrum caps in respect of the geographic interleaved spectrum, either on a standalone basis or linked to the general safeguard spectrum cap of 50 MHz suggested for the cleared award.

Question 1. The executive summary sets out our proposals for the digital dividend geographic interleaved award. Do you agree with these proposals?

Next steps

1.18 This consultation closes on 21 August 2008. We are planning to hold a seminar on our proposals during the consultation period. More information about the next steps is set out in section 11 of this consultation.

Section 2

Introduction

2.1 The first phase of the DDR concluded with the publication of the DDR statement in December 2007. In it, we set out our decisions on the strategic approach we would take to the release of the UK's digital dividend – the spectrum freed up by DSO. Some of those key decisions were as follows:

- We confirmed our proposal to take a market-led approach to awarding the digital dividend and in doing so we decided to auction this spectrum, hence giving users flexibility to decide its optimum use. Auctions are the most open, transparent and non-discriminatory way of determining who should hold licences. A well designed auction process should have an efficient outcome, i.e. it should give the maximum flexibility for the market to determine the highest value use of the spectrum and the identity of the users.

- We decided not to intervene to reserve the spectrum for any particular use except for a single package of interleaved spectrum with obligations toward programme-making and special events (PMSE), which will be awarded via a beauty contest.

- We decided to auction geographic lots of interleaved spectrum suitable but not reserved for local television.

- We decided to include channel 36 in the award of the cleared spectrum and proposed to award the interleaved spectrum in channels 61 and 62 alongside this spectrum.

- We proposed to allow licence-exempt cognitive devices access to the interleaved spectrum but decided not to set aside any of the digital dividend exclusively for licence-exempt use or as an innovation reserve.

- Finally, we decided to continue with our timetable of awarding the digital dividend as soon as possible, with the auction for the first geographic interleaved lots proposed for later in 2008 or early 2009 and the remainder later in 2009.

2.2 On 6 June we published a consultation setting out our proposals on the detailed design of the award of the cleared spectrum (the 'cleared consultation')[5] and we will publish a further consultation on the award of a single lot of interleaved spectrum with obligations to PMSE users, later in the summer. Later this year, we will also publish a consultation document which will set out our proposals for giving licence-exempt cognitive devices access to the interleaved spectrum.

2.3 This document focuses on our proposals for the detailed design of the awards of geographic lots of interleaved spectrum (the geographic interleaved awards).

Different types of spectrum

2.4 There are several different types of spectrum available for release as part of the digital dividend. The principal distinction that we make is between the 'cleared' spectrum and the 'interleaved' spectrum. These categories are explained below.

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

2.5 Cleared spectrum is spectrum that will be available on a UK-wide basis for new uses after DSO. Most of this spectrum comprises spectrum that will be cleared as a direct consequence of digital switchover, which will release 14 x 8 MHz channels, i.e. 112 MHz. This spectrum corresponds to channels 31-35, 37, 39-40 and 63-68.

2.6 We recognised at an early stage of the DDR that other UHF channels had potential to be cleared on a similar timeframe.

- In the DDR statement, we set out our decision to auction channel 36, which is expected to be cleared of its current use by April 2009, alongside the other cleared spectrum.
- We also made a proposal to include the interleaved spectrum in channels 61 and 62 in the cleared award.
- We decided that channel 69 should continue to be available for PMSE use throughout the UK on a licensed basis, and be included in the package of interleaved spectrum with obligations toward PMSE.
- Since the publication of the DDR statement, we have discussed future use of channel 38 with the Department for Innovation, Universities and Skills (DIUS) and the Science and Technology Facilities Council (STFC) - the bodies responsible for radio astronomy in the UK. They have decided to vacate the channel in time for the completion of DSO in 2012. Accordingly, we have decided to include channel 38 in the DDR cleared award.

2.7 In summary, the cleared award will include 128 MHz of spectrum available UK-wide in two blocks of 550-630 MHz (the lower sub-band) and 806-854 MHz (the upper sub-band) as well as 16 MHz of interleaved spectrum between 790-806 MHz. All of this spectrum will be fully available for new use by 2012 at the latest and is the subject of the cleared consultation[6].

2.8 The digital dividend also includes the 'interleaved' spectrum that will be available within the 256MHz of spectrum that will be used to carry the existing DTT multiplexes.

2.9 This interleaved spectrum is effectively 'white space' that will exist between transmission sites used for DTT multiplex coverage after DSO. Similar white space exists at present in analogue broadcasting. The white space arises because, in a multiple frequency network (MFN), any television channel (or multiplex) is carried on a number of different frequency channels around the country. On any given frequency channel used in this way there will be a geographical zone where use for high-power broadcasting is not possible because of the interference it would cause, but use for low power (non-DTT) applications is possible, provided these are carefully designed so as to be compatible with the primary, broadcast use. The white space of this kind that exists in the analogue world will disappear with the end of analogue transmission, but new white space will come into existence in between the expanded DTT networks.

2.10 Both categories of spectrum (cleared and geographic interleaved) comprise the digital dividend. The scope of the DDR extends to consideration of all of this available UHF spectrum.

[6] Digital Dividend Review: 550-630 MHz and 790-854 MHz. Consultation on detailed award design, Ofcom, 6 June 2008, http://www.ofcom.org.uk/consult/condocs/clearedaward/

2.11 Figure 2.1 below shows these different categories of spectrum in the context of the wider use of UHF between 470 and 862MHz. There are different ways of referring to the spectrum in UHF– it is often referred to by 'channel number', each channel representing 8 MHz of spectrum. The spectrum can also be referred to using frequencies. For example, channel 21 occupies the frequency range 470-478 MHz.

Figure 2.1 The available UHF spectrum; channel numbers and frequency ranges

2.12 At the most fundamental level, spectrum is typically a substitutable resource – one channel or block of spectrum will be an alternative for other channels, to a greater or lesser degree depending on basic physical characteristics. But it is important to note that, in practice, the differences between channels can be greater than this. In particular, additional constraints on use can be created by international agreements and the need to prevent interference with other services within the UK. These constraints can vary significantly between channels.

The geographic interleaved awards

2.13 Our objective in awarding the digital dividend is to maximise the total value to society that using this spectrum is likely to generate over time. It is not our objective to manage the spectrum so as to raise revenue for the Exchequer – nor, given our statutory duties, is this a consideration that we take into account.

2.14 In the first phase of the DDR, we considered all potential sources of private and social value that could be delivered through the use of the DDR spectrum. We looked in detail at citizen and consumer interests in relation to all the likely uses of the spectrum. We undertook two major rounds of market research using a variety of techniques to discover the opinions of citizens and consumers on the options for using the spectrum. We carried out extensive technical research and detailed economic analysis and modelling. We also gave careful consideration to hundreds of consultation responses in order to finalise our policy approach to the release of this valuable spectrum. All of this helped us decide on the approach to the award of DDR

spectrum which we believe best meets our statutory duties and objective for the DDR.

2.15 In the DDR statement, we explained our intention to award one or two geographic channels of interleaved spectrum suitable but not reserved for local TV in about 25 locations with known or likely demand for this use. We looked at the level of population coverage that might be required for a local TV service to be commercially viable as well as areas where there are existing Restricted Television Service Licences (RTSLs) for local TV. We considered adding further locations identified by potential providers, including community operators.

2.16 Since we published the DDR statement, in relation to this award we have:

- informally sought views from stakeholders on the locations of channels or lots to be made available via auction. As a result of this process we have decided to add a number of additional sites to our proposed list; and

- carried out further technical research into the impact of new services in the interleaved spectrum on existing DTT services. Consequently, we propose to modify the previous technical criteria that new services would need to respect in order to operate in the interleaved spectrum.

2.17 We are now consulting on possible locations in this next phase of the DDR. The sites we have identified are set out in Table 6.1. We invite views on whether to add more sites to, or indeed subtract sites from, this list by inviting interested parties to provide further evidence of demand where appropriate.

2.18 In this document we specifically consider:

- the most likely potential uses of the spectrum and the possibilities for combining lots to match cultural and/or administrative boundaries;

- the definition of spectrum rights and obligations which best reflect the likely demand for the spectrum and the specific technical constraints on the spectrum;

- the selection of auction formats and rules which provide the best fit for the available geographic interleaved spectrum, enable bidders to express their true value for the spectrum and encourage innovation in the form of new entry, new services and new technologies;

- the choice of technical licence conditions which provide maximum flexibility to implement different potential uses of the spectrum while affording sufficient protection for existing and new users of the spectrum from harmful interference, thereby preserving the inherent value of this natural resource;

- the choice of non-technical usage rights and obligations which will apply to licensees, including the licence term and the ability to trade spectrum, to provide certainty of tenure for winners of spectrum and enable maximum flexibility for the spectrum to pass to those who value it most over the course of time[7];

- the design of the awards that can best promote competition and innovation in downstream markets and guarding against the possibility of anti-competitive behaviour.

[7] We discuss possible variations of the licence in paragraphs 8.17 to 8.18.

Structure of this document

2.19 This document is structured as follows:

- In section 3, we set out the legal and regulatory framework within which we operate.
- In section 4, we explain our understanding of the likely demand and potential uses of the spectrum.
- In section 5, we set out our assessment of the possible geographic coverage and implications of new DTT services using the spectrum to be awarded, and the possibilities for combining lots to match cultural and/or administrative boundaries.
- In section 6, we make proposals for the types of spectrum lots which best reflect the likely demand for the spectrum and the specific technical constraints on the spectrum.
- In section 7, we make proposals for auction formats and rules which provide the best fit for the available lots of spectrum proposed in section 6.
- In section 8, we set out our assessment of the technical licence conditions that we propose to apply to this spectrum.
- In section 9, we set out the non-technical licence conditions we propose to include in the Wireless Telegraphy Act Licences that we will award to successful bidders following the auctions of this spectrum.
- In section 10, we explain our approach to competition and efficiency, how our general approach to awarding and managing spectrum is designed to promote both competition and efficiency and how this approach should be applied in the context of the geographic interleaved awards.
- In section 11, we set out the next steps for these awards.

Section 3

Legal and regulatory framework

3.1 In this section, we describe our functions, duties and objectives as they relate to these awards. We also provide a brief overview of the international regulatory provisions that impact on the potential future uses of the digital dividend.

Ofcom's duties and objectives

3.2 We make decisions within a framework defined in European Union (EU) and UK law. This sets out overarching general duties, which apply across all our functions, below which sit a number of specific duties[8].

The duties imposed by the Communications Act 2003

3.3 Section 3 of the Communications Act sets out our general duties and provides that our principal duties are:

- 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.

3.4 In securing the above duties, we are required to secure among other things the optimal use for wireless telegraphy of the electro-magnetic spectrum and the availability throughout the UK of a wide range of electronic communication services and to have regard to the different needs and interests of everyone who may wish to use the spectrum for wireless telegraphy.

3.5 Section 3(3) of the Communications Act provides that in performing our principal duties, we must in all cases have regard to the principles of transparency, accountability, proportionality and consistency as well as ensure that our actions are targeted only at cases in which action is needed.

3.6 Section 3(4) of the Communications Act requires us in performing our principal duties, to have regard to a number of factors as appropriate, including the desirability of promoting competition, encouraging investment and innovation in relevant markets and encouraging the availability and use of high speed data transfer services throughout the UK.

3.7 Where there is a conflict between the duties, priority must be given to the European Community requirements set out in section 4.

European Community requirements

3.8 Section 4 of the Communications Act implements article 8 (policy objectives and regulatory principles) of the Framework Directive[9]. This sets out objectives that

[8] See Annex 6 of the DDR statement for a more detailed overview of the statutory duties relevant to the DDR.

[9] Directive 2002/21/EC of the European Parliament and of the Council of 7 March 2002, on a common regulatory framework for electronic communications networks and services (Framework Directive), http://eur-lex.europa.eu/pri/en/oj/dat/2002/l_108/l_10820020424en00330050.pdf

national regulatory authorities must take all reasonable steps to achieve. These include the promotion of competition in the provision of electronic communications networks and services by, among other things, encouraging efficient investment in infrastructure and promoting innovation, and encouraging efficient use of radio frequencies; and contributing to the development of the internal market by, among other things, removing obstacles to the provision of electronic communications networks and services at a European level, encouraging the interoperability of pan-European services and ensuring that, in similar circumstances, there is no discrimination in the treatment of undertakings providing electronic communications networks and services.

3.9 Article 8 also requires EU Member States to ensure that in carrying out their regulatory tasks, national regulatory authorities take the utmost account of the desirability of making regulations technologically neutral.

Our duties when carrying out our spectrum functions

3.10 In carrying out our spectrum functions, we have a duty under section 3 of the Wireless Telegraphy Act 2006 to have regard in particular to:

a) the extent to which the spectrum is available for use or further use, for wireless telegraphy;

b) the demand for use of that spectrum for wireless telegraphy; and

c) the demand that is likely to arise in future for the use of that spectrum for wireless telegraphy.

3.11 We also have a duty to have regard, in particular, to the desirability of promoting:

a) the efficient management and use of the spectrum for wireless telegraphy;

b) the economic and other benefits that may arise from the use of wireless telegraphy;

c) the development of innovative services; and

d) competition in the provision of electronic communications services.

3.12 Where it appears to us that any of our duties in section 3 of the Wireless Telegraphy Act conflict with one or more of our general duties under sections 3 to 6 of the Communications Act, priority must be given to our duties under the latter. Section 5 of the Communications Act concerns our obligation to carry out our functions in accordance with any directions made by the Secretary of State. Section 6 concerns our duties to review regulatory burdens.

Granting Wireless Telegraphy Act licences

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

3.14 Section 9(1) of the Wireless Telegraphy Act gives us the power to grant wireless telegraphy licences subject to such terms as we think fit.

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

3.16 Under section 8(4) of the Wireless Telegraphy Act, we have the duty to exempt from licensing any use of wireless telegraphy apparatus that we consider is not likely to cause harmful interference. Licence-exemptions are granted by way of regulations made under section 8(3).

Providing for an auction of wireless telegraphy licences

3.17 Under Article 5(2) of the Authorisation Directive[10], when granting rights of use of radio frequencies (wireless telegraphy licences in the UK context), Member States must do so through open, transparent and non-discriminatory procedures.

3.18 Under Article 7(2) of the Authorisation Directive where the number of rights of use of radio frequencies needs to be limited, Member States' selection criteria must be objective, transparent, non-discriminatory and proportionate. Section 29 of the Wireless Telegraphy Act requires us to make an order setting out the criteria.

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

3.20 We have broad powers under section 14 to make provision in regulations for the form of the licences and the auction procedure.

Charging fees for wireless telegraphy licences

3.21 Under Article 13 of the Authorisation Directive, any fees imposed for rights of use of radio frequencies must reflect the need to ensure the optimal use of the resources. Such fees must be objectively justifiable, transparent, non-discriminatory and proportionate in relation to their intended purpose and take into account the objectives set out in Article 8 of the Framework Directive.

3.22 Section 12 of the Wireless Telegraphy Act permits charging for wireless telegraphy licences by enabling us to prescribe in regulations sums payable for these licences. This power enables us to recover the cost of administering and managing wireless telegraphy licences. Section 13 of the Wireless Telegraphy Act permits us to recover sums greater than these if we think fit in the light (in particular) of the matters to which we must have regard under section 3 of that Act, including promoting the efficient management and use of the part of the electromagnetic spectrum available for wireless telegraphy.

[10] Directive 2002/20/EC of the European Parliament and of the Council of 7 March 2002 on the authorisation of electronic communications networks and services (Authorisation Directive), http://eur-lex.europa.eu/pri/en/oj/dat/2002/l_108/l_10820020424en00210032.pdf

3.23 The fees for most wireless telegraphy licences (including those fees that we set out in order to incentivise the efficient use of the spectrum) are set out in specific regulations. The current regulations are the Wireless Telegraphy (Licence Charges) Regulations 2005 (SI 2005/1378) as amended[11].

Objective for the DDR

3.24 Taking account of our duties and our spectrum management strategy, and as set out in the 2006 DDR consultation document[12] and the DDR statement, 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.

International Regulatory framework for electronic communications

3.25 Spectrum management in the UK takes place within international frameworks set both globally and in the EU. Some international constraints arise from the UK's obligations as a member of the International Telecommunication Union (ITU) which is an agency of the United Nations.

The Geneva 06 agreement

3.26 A major ITU conference (The Regional Radio Conference, 'RRC-06') held in Geneva in 2006 agreed a plan allowing for the transition from analogue to digital broadcasting in Europe and other regions. This plan does not require the UK, or any other signatory, to license spectrum for digital television, but it does require the UK to protect uses of spectrum in other countries. Conversely, the UK has rights of protection from uses abroad.

3.27 The Regional Radio Conference 2006 (RRC-06) produced a new Agreement, which has the status of an international treaty (called the Geneva 2006 Agreement – 'GE-06') and was signed by 101 countries from Europe, Africa, and the Middle East. The Agreement came into force on 17 June 2007 but signatories agreed to apply its terms provisionally from 17 June 2006.

3.28 Under GE-06 the UK has been granted the right to assign specific frequencies for digital terrestrial broadcasting, at specific power levels to transmission sites at particular locations in the UK. These assignments are listed in a document called the Digital Plan ('the GE-06 plan'), which forms part of GE-06. Within the GE-06 plan, the UK obtained the rights to operate up to eight DTT multiplexes within the UHF spectrum. In each geographic area in the UK, the bulk of these frequencies will be used for the existing DTT multiplexes that are already planned to operate after DSO (three PSB multiplexes and three commercial multiplexes). Frequencies suitable for the two remaining multiplexes comprise the cleared spectrum. Neighbouring countries also secured assignments that they are expected to adopt as part of their switchover programmes.

3.29 Although GE-06 and the GE-06 plan are focussed predominantly on broadcasting services, it is possible to use the GE-06 plan entries for uses other than broadcasting. A large number of countries, including the UK and all of its neighbours,

[11] http://www.opsi.gov.uk/SI/si2006/20062894.htm
[12] *Digital Dividend Review. This document consults on the proposed approach to the award of the digital dividend spectrum (470-862MHz),* Ofcom, 19 December 2006. http://www.ofcom.org.uk/consult/condocs/ddr/ddrmain.pdf

signed a declaration formally stating that they may use their GE-06 plan rights for broadcasting or other terrestrial applications with characteristics that may be different from those appearing in the GE-06 plan, on the condition that this different use remains within the envelope of their GE-06 plan entries. Furthermore, this declaration provided an agreement that any such use will be afforded protection to the levels defined by the interfering field strengths as arising from their GE-06 plan entries, taking into account any relevant bilateral agreements[13].

3.30 It is also important to note that if the spectrum is used for digital terrestrial broadcasting or another use requiring high-powered transmitters at sites other than those specified in the GE-06 plan, then the user must ensure that the field strengths generated in other countries will be no greater than would be produced from assignments in the GE-06 plan. If these conditions are met these assignments will be protected from international interference by neighbouring countries under the GE-06, to the extent that assignments in the GE-06 plan would be protected.

3.31 The overall impact of the above provisions is that the UK has the flexibility to use the assignments in the GE-06 plan for any purpose as long as it does not cause more interference, or require more protection, than if it were used strictly in accordance with the GE-06 and the Plan. Any use of the digital dividend spectrum in the UK will have to comply with the international obligations arising from GE-06 and any subsequent bilateral agreements (see section 5/6).

The EU and other international developments

3.32 Spectrum management in the UK takes place within international frameworks set both globally and in the EU. Under the Radio Spectrum Decision[14], the European Commission (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.

3.33 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.

3.34 Three recent developments are particularly relevant to the geographic interleaved awards.

[13] At the Regional Radiocommunication Conference in 2006, 53 countries signed a declaration, formally declaring that their administrations may use their digital Plan entries for broadcasting or other terrestrial applications with characteristics that may be different from those appearing in the Plan within the envelope of their digital Plan entries under the provisions of the GE-06 Agreement and the Radio Regulations, and that their administrations agree that any such use will be afforded protection to the levels defined by the interfering field strengths as arising from their digital Plan entries, taking into account any relevant bilateral agreements, This declaration is available in the Final Acts of the RRC.

[14] Decision No 676/2002/EC of the European Parliament and of the Council of 7 March 2002 on a regulatory framework for radio spectrum policy in the European Community (Radio Spectrum Decision), http://eur-lex.europa.eu/LexUriServ/site/en/oj/2002/l_108/l_10820020424en00010006.pdf.

3.35 First, the World Radiocommunication Conference 2007 (WRC-07) agreed in November 2007 to change the international Radiocommunication Regulations to make spectrum currently used for analogue television more flexible, in particular enabling mobile use.

3.36 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.

3.37 Second, also in November 2007, the Commission published a Communication on a common approach to the digital dividend in the Europe[15]. 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. The Communication was published at the same time as a package of proposals for amending the legislation defining the EU regulatory framework for electronic communications networks and services.

3.38 Third, the European Conference of Postal and Telecommunications Administrations (CEPT), in its response to an earlier Commission mandate on this issue, concluded that the preferred sub-band for the harmonised mobile broadband cluster proposed by the Commission is the upper part of the UHF band V and should include, as a minimum, channels 62-69 (798-862 MHz), as offering the best possibility for Europe-wide non-mandatory, non-exclusive harmonisation[16]. This same spectrum including channel 61 (thus expanding the range to 790-862MHz) was then subsequently the subject of decisions at WRC-07 to enhance flexibility for mobile usage.

3.39 Following a further Commission mandate, work continues within CEPT to identify common technical conditions and international coordination and channelling arrangements. These reports are expected to be available in draft form from the end of 2008, for final delivery by June 2009.

3.40 We expect the following key outputs in relation to the digital dividend to occur between now and March 2009:

- in June 2008, conclusions from the Council of Ministers on the Commission Communication;
- in September 2008, a resolution from the European Parliament on the Commission Communication; and
- In March 2009, draft proposals developed by CEPT in response to the most recent Commission mandate.

3.41 We will continue to contribute fully to EU discussions in the months to come and we believe that our proposals for the UK digital dividend are not in conflict with

[15] *Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Reaping the full benefits of the digital dividend in Europe: A common approach to the use of the spectrum released by the digital switchover,* November 2007, http://ec.europa.eu/information_society/policy/ecomm/doc/library/proposals/com_dd_en.pdf

[16] http://ec.europa.eu/information_society/policy/radio_spectrum/activities/rsc_work/mandates/index_en.htm

discussions currently underway in the above fora. In the meantime, in line with the decision set out in the DDR statement, we believe it right to press ahead with the digital dividend awards in the interests of bringing benefits to UK citizens and consumers at the earliest possible date.

Section 4

Uses of the geographic interleaved spectrum

Introduction and summary

4.1 In order to both specify an approach to packaging and auction design that promotes competition and efficiency and to specify appropriate licence conditions we first need to understand the likely uses of the spectrum available.

4.2 Evidence collected to date suggests some services and technologies are more likely to use the digital dividend than others. In the first phase of the DDR, we conducted two major rounds of market research. We also received evidence from consultation responses, our technical research and economic modelling. Our analysis therefore focused closely on the most likely uses.

4.3 For the interleaved spectrum, the most likely uses that we identified were DTT services, PMSE services and cognitive devices (implications for the last two uses will be the subjects of separate consultations). There are also other potential uses, such as mobile broadband and mobile TV. These are generally thought to be more suited to the cleared spectrum but interleaved spectrum may be an acceptable substitute or, in some cases, complement.

4.4 In this section we:

- describe the potential and likely uses of the geographic interleaved packages; and
- summarise the most recent stakeholder research we have undertaken in this area.

DTT

4.5 The geographic interleaved spectrum could be used by multiplex operators interested in aggregating the lots in order to form a sub-UK wide multiplex or a multiplex based around a single UK nation (Northern Ireland, Wales or Scotland) or a wider English region. A broadcaster may also be interested in acquiring geographic interleaved spectrum to fill gaps in coverage in a DTT multiplex deployed in the cleared spectrum.

4.6 Alternatively, multiplex operators could bid for a number of geographic lots with a view to broadcasting the same content across a number of separate areas on a regional or sub-national basis. The content need not be locally orientated material.

4.7 A multiplex operator may also seek to aggregate a number of separate (and not necessarily contiguous) geographic lots to form a network of local TV stations, perhaps in a number of major cities, and/or create regional or national multiplexes at the sub-UK level.

4.8 An aggregated multiplex may provide additional opportunities for local TV or other operators to negotiate access to a video stream. But it will also be suitable for other

non-local services or geographic services based on an area significantly broader than a local area.

Local TV

4.9 Local TV may be characterised as a TV 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). Transmission areas will typically be smaller than existing BBC and ITV regions. Local TV may be operated on a wholly commercial basis, as a not-for-profit community model, or as a combination of both.

4.10 In 2005 with the Department of Culture, Media and Sport (DCMS), we commissioned the consultancy Spectrum Strategy to assess the commercial viability of delivering local digital services to provide input into our consultation Digital Local[17]. Spectrum Strategy found that services delivered to urban areas and to smaller communities were not likely to be viable on a purely commercial basis. They considered that only local digital TV propositions serving large metropolitan areas were viable on a commercial basis, though they suggested that more favourable outcomes might be achieved if a network-affiliate model was adopted in which numerous local TV stations shared costs and jointly marketed their airtime. This work was recently reassessed by Phillipa Marks, a consultant, and in the light of more recent market research and evidence she concluded that Spectrum Strategy's conclusions were over-optimistic[18].

4.11 In the DDR statement we said that reserving spectrum would do little to improve the commercial business case for local TV given the high costs involved in producing content that viewers want to watch and the challenging business model of local TV in the UK. We concluded that in instances where there was broader social value for local TV the challenging commercial business case should be addressed by direct funding rather than by specifically reserving spectrum.

4.12 A small number of local TV services are currently licensed in analogue form under restricted television service licences (RTSLs), and there is now interest from these licensees in using the available geographic interleaved spectrum in these areas to offer local TV services in digital form via DTT. Examples of existing terrestrial local TV services include Channel M in Manchester (backed by Guardian Media Group), 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). Channel M and MATV are also available via cable and satellite.

PMSE

4.13 Programme makers, commercial theatres and event organisers use spectrum to relay sound and picture data across relatively short distances. This allows, for example, wireless microphones to be used on stage in musical theatre, and at events such as Live 8 and T in the Park. Other major uses include in-ear monitoring equipment and talkback.

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[17] *Digital Local - Options for the future of local video content and interactive services*, Ofcom, 19 January 2006, http://www.ofcom.org.uk/tv/psb_review/digital_local/

[18] *Comments on the "Economics of Local Digital Audiovisual and Interactive Services", a paper for Ofcom and the DCMS by Spectrum Strategy*, 6 November 2007, Phillipa Marks, submitted to the Competition Commission. http://www.competition-commission.org.uk/Inquiries/ref2007/macquarie/pdf/prov_findings_working_paper_1.pdf

4.14 Audio links for PMSE (including wireless microphones, in-ear monitoring equipment and talkback) already use existing interleaved spectrum. In all cases, the use tends to be low power. Many PMSE uses require assured quality of service to guard against the risk of interference. The digital dividend is suitable for this use partly because these users have already invested in equipment that is tuned to work at the available UHF frequencies. Actual demand for PMSE use of the spectrum is expected to rise with time, particularly for special events. One spur to demand currently foreseen is the 2012 London Olympics.

4.15 We have decided to award most of the available interleaved spectrum by 'beauty contest' to a band manager, who will be required to make spectrum available for PMSE users. Further detailed proposals regarding PMSE will be contained in a separate consultation in relation to that award (the band manager award) to be published later in the summer. There may be interest from PMSE stakeholders in acquiring geographic interleaved spectrum via auction to supplement the spectrum available via band manager's primary award.

Mobile broadband

4.16 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). Our 2007 market research[19] indicated that improved mobile phone and mobile broadband services generate high value for citizens and consumers.

4.17 The operation of mobile broadband services in interleaved spectrum is still being investigated. If this is feasible - particularly for downlinks - geographic interleaved lots could provide new or extended access on a sub-UK basis, for example, in areas not served via fixed lines or existing wireless networks on higher frequencies.

Mobile TV

4.18 The DDR statement noted the suitability of the UHF bands for providing mobile TV. It noted the suitability of other spectrum, some of which, at L-Band (1452-1492 MHZ) has been awarded. We announced on 4 April 2008 plans to auction additional spectrum at 2.6 GHz later in 2008, with an expected application date in July. Since then T-Mobile and O2 have begun legal challenges of our decision to press ahead with the award. In light of this we have decided that it would be inappropriate to set the application date for July or August 2008. As soon as we are in a position to do so we will provide further information on the timing of the application and auction processes. Additionally, mobile multimedia services are already being offered over 3G.

4.19 According to the results of our 2007 market research, consumer interest in mobile TV appears to be lower than in other potential uses of the digital dividend, though a significant minority of consumers appear very interested. Additionally, mobile TV 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 TV. There is an interest in acquiring spectrum for this use among those with an established interest in mobile cellular service, and broadcasting. Interest is focused on acquiring cleared spectrum, but again, geographic interleaved lots could provide new or extended access on a sub-UK basis.

[19] http://www.ofcom.org.uk/radiocomms/ddr/documents/research07/

Summary of stakeholder research

4.20 In preparation for the second phase of the DDR, we have undertaken further focused stakeholder research to understand the services that potential users of the geographic interleaved spectrum will wish to provide, given that the sector and the technologies it uses are rapidly evolving. Stakeholders continued to identify the following services that they believe are most likely to be offered using the geographic interleaved spectrum:

- new DTT services aimed at a UK market in either Standard Definition (SD) or High Definition (HD); and
- new DTT services aimed at local markets (i.e. local TV).

4.21 This stakeholder research supports our view that we have identified the most likely uses of the geographic interleaved spectrum as DTT.

4.22 Of course, it is possible that more potential uses will emerge in future, as technology changes and innovators create new products. The benefits of these unknown uses could be as large as, or larger than, the benefits of uses that we can identify now. It may be that these technologies will not fit neatly into the spectrum lots that we are proposing for this award.

4.23 Our proposal to make these licences fully tradable should alleviate some concerns about our ability to 'future proof' the licences. The spectrum could be traded fully or partially. Partial trades could involve trading geographical or frequency parts of the licence. For example, if a future technology only required a 4 MHz bandwidth, and a licensed user of the 8 MHz channel that we are proposing to award could trade half of its licensed spectrum to another operator. In addition, we would consider applications to change technical conditions in licences as appropriate.

4.24 However, we acknowledge the importance of ensuring that the primary award (i.e. when the spectrum is first released to the market) delivers efficient outcomes based on current knowledge, and that these, in turn, deliver significant benefit to citizens and consumers in making the right choices. We consider that the time and cost involved in preparing the primary award will be justified by the benefits that it could bring.

Question 2. Do you have any comments on our assessment of the most likely uses of the geographic interleaved lots? Are there any potential uses which should be considered that we have not mentioned?

Licence-exempt cognitive devices' access to the interleaved spectrum

4.25 In the DDR statement, we considered the use of interleaved spectrum for licence-exempt applications and proposed allowing cognitive devices access as long as we were satisfied that it would not cause harmful interference to licensed use of the interleaved spectrum.

4.26 We consider here which licensed uses of the interleaved spectrum we should specifically protect from harmful interference. Responses on this issue will inform a separate consultation on licence-exempt cognitive devices access to the interleaved spectrum, which we expect to publish later this year.

Cognitive devices

4.27 A cognitive device scans the available spectrum, determines which parts of it are currently unused and, as needed, makes use of this spectrum when it has information to transmit. Cognitive devices are often described as being particularly suited for high-bandwidth services such as home and business networks, community and campus networks and municipal Wi-Fi.

4.28 In the DDR statement, we considered whether the interleaved spectrum was usable for low-power and/or licence-exempt cognitive devices. We considered whether the characteristics of this spectrum made it suitable for this type of use, and we examined the merits both of allowing cognitive devices access and of a dedicated licence-exempt allocation. We concluded that reserving spectrum for licence-exempt use would not be appropriate, because of the very high opportunity costs in displacing potential licensed uses and the fact that potential licence-exempt uses could be accommodated more effectively in higher frequency spectrum. In contrast, we concluded that cognitive devices could make flexible use of the interleaved spectrum without causing harmful interference to licensed users, depending on the development of effective spectrum sensing technology.

4.29 In allowing licence-exempt cognitive devices access, it is important to specify a number of parameters so that cognitive devices do not interfere with licensed use. Key among these are the sensitivity of the cognitive device to detecting signals from other users and the power levels it is allowed to transmit. These parameters will be a key element for consultation.

Specifying services to protect

4.30 It is generally not possible to design a cognitive device to be able to detect and avoid any service that might be deployed in the future. As a result of this there is a need to specify in advance parameters for those services that could credibly be deployed in the interleaved spectrum and that cognitive devices should be specifically designed to avoid. It is important to strike the right balance between protecting valuable services while at the same time not imposing unnecessary restrictions on cognitive devices.

4.31 Equally, services that are not explicitly protected will not necessarily suffer harmful interference. Cognitive devices will tend to avoid spectrum in which they have detected signal energy. While they may be worse at detecting services to which they have not been tuned than those for which they have been specifically designed, some degree of protection will nevertheless be conferred. We also anticipate that, in most cases, harmful interference will be transitory as devices move past each other or turn on and off. For example, interference from cognitive devices to mobile television receivers may be less problematic than a reduction in signal strength experienced inside a building.

4.32 There is also a risk that new services will subsequently emerge that do merit protection. We considered this issue in the DDR statement and concluded that we needed to be mindful of the potential for access for cognitive devices to have a negative impact on the future usability of interleaved spectrum when specifying the parameters for this use.

4.33 Cognitive devices would need to ensure they did not cause harmful interference to DVB-T transmissions. We consider this should apply to licence holders irrespective

of the geographic coverage of their services. We also expect to see DVB-T2[20] introduced in the near future and consider that such services should be protected from harmful interference.

4.34 Protection should also be afforded to PMSE use. This represents a broad category of technologies and applications. We suggest that protection be offered to currently available wireless microphones, in-ear monitors and talkback systems.

4.35 It is possible that other services, such as mobile television and two-way mobile, might be deployed in the interleaved spectrum. To determine whether to offer protection to such services we would need to consider the likelihood of the services being deployed and the value they might bring to users, compared to the reduction in value that would result from cognitive devices avoiding such services. We do not believe that there is currently enough information available to determine this quantitatively. However, we can examine the implications on cognitive devices of avoiding mobile television.

4.36 The key problem we envisage with cognitive devices and mobile television receivers is the possible interference caused when they are in proximity. It is possible that a mobile television receiver and a cognitive device might be within a few metres of each other (e.g. in a railway carriage). In this situation, modelling shows that even if the cognitive device detects a mobile television transmission and avoids using the channel as well as adjacent channels, interference can still result. This is because the out-of-band filtering of the mobile television handset may be insufficient to remove it. Only by restricting the transmit power of the cognitive device to levels of around 1 mW can interference be avoided. Such a low transmit power level would, in our view, render the cognitive device of little value.

4.37 Broadly, our conclusions are that mobile television and cognitive devices cannot coexist in the same spectrum unless the out-of-band performance of mobile television handsets is substantially improved above current specifications, by at least 20 dB. Hence, if we conclude that mobile television transmissions in the interleaved spectrum should be protected, we effectively prevent the use of cognitive devices. We should, therefore, only protect mobile television transmission if we have reasonable expectations that it will be deployed and will provide significant consumer value. We plan to consider this further in our forthcoming consultation on allowing cognitive devices licence-exempt access to the interleaved spectrum.

Question 3. Are there any other types of DTT transmission that should be protected from potential cognitive devices or other factors that we should take into account?

Question 4. Are there any potential future PMSE applications, other than currently available wireless microphones, in-ear monitors and talkback systems, that you consider should be protected from potential cognitive devices?

Question 5. Is there sufficient evidence to require protection for other services such as mobile television, bearing in mind the potentially negative implications of such protection for deployment of cognitive devices?

[20] DVB-T2 is an update of DVB-T, the current standard for DTT transmission which has been in use in the UK since 1998. DVB-T2 is currently undergoing standardisation and is expected to give at least a 30 per cent increase in multiplex capacity over the current standard whilst maintaining the same coverage.

Conclusions

4.38 In the light of responses to this consultation, we will form a judgement on the services that we believe should be explicitly protected from harmful interference from licence-exempt cognitive devices in the interleaved spectrum. We will issue a consultation later in the year detailing the required parameters for cognitive devices in order to achieve this.

4.39 Having considered possible uses of the geographic interleaved digital dividend and stakeholder research we have concluded that most interest in this spectrum is likely to come from parties wishing to provide DTT services. However, we acknowledge that there could be interest in acquiring geographic interleaved lots to provide other services including PMSE, mobile broadband and mobile television.

Section 5

Coverage and impact of new DTT services

Introduction and summary

5.1 Because DTT has emerged as the most likely use of the geographic interleaved spectrum (see paragraphs 4.5-4.24), we need to understand the coverage that they could achieve across and within the UK in order to identify an approach to packaging and auction design. The studies we commissioned found that a range of coverage scenarios are possible including UK- wide, nations, regions, metropolitan and communities. We need to understand the impact of such new DTT services on the coverage of the existing DTT multiplexes. We also need to decide to what extent we protect the existing DTT multiplexes and reduce risk of disruption to future reception while balancing the usability of the geographical interleaved lots for new services.

5.2 In this section, we:

- describe the potential coverage for new DTT services; and
- describe the potential impact on existing DTT services and set out proposals on the appropriate level of protection.

Potential coverage for new DTT services

5.3 As set out in section 4, a variety of applications can potentially use geographic interleaved spectrum to deliver services. This subsection looks in more detail at the potential coverage that could be achieved by new DTT services at different geographic levels. We focus on DTT for two interrelated reasons:

- we believe that it is the most likely use of the geographic interleaved spectrum in its own right rather than as providing supplementary capacity to other spectrum holdings; and
- we have found it both necessary and desirable to assess coverage in more detail to further inform our own and potential operators' understanding of the possibilities.

5.4 The following subsections are by no means exhaustive in describing how geographic interleaved spectrum could be used to provide new DTT services, but we believe that they are broadly representative of the range of possibilities. Please note that the predicted coverage and figures provided are indicative only.

Terrestrial television transmission

5.5 Terrestrial television is broadcast from 80 medium to high power transmission sites and over 1,000 lower to medium power relay transmission sites distributed throughout the UK. The main transmission sites are generally high power, located on high tower sites and cover large geographical areas (typically 60km radius) with high population. The relays generally operate at medium to low power using shorter masts, with coverage ranging from towns and cities to small communities.

5.6 We propose to group potential auction lots, given the existing transmission infrastructure, as follows:

- large lots – main transmission sites that offer widespread geographical and/or high population coverage.
- medium lots – main transmission sites and relay transmission sites that offer more targeted, significant population coverage.
- small lots – relay transmission sites that offer localised geographical and population coverage.

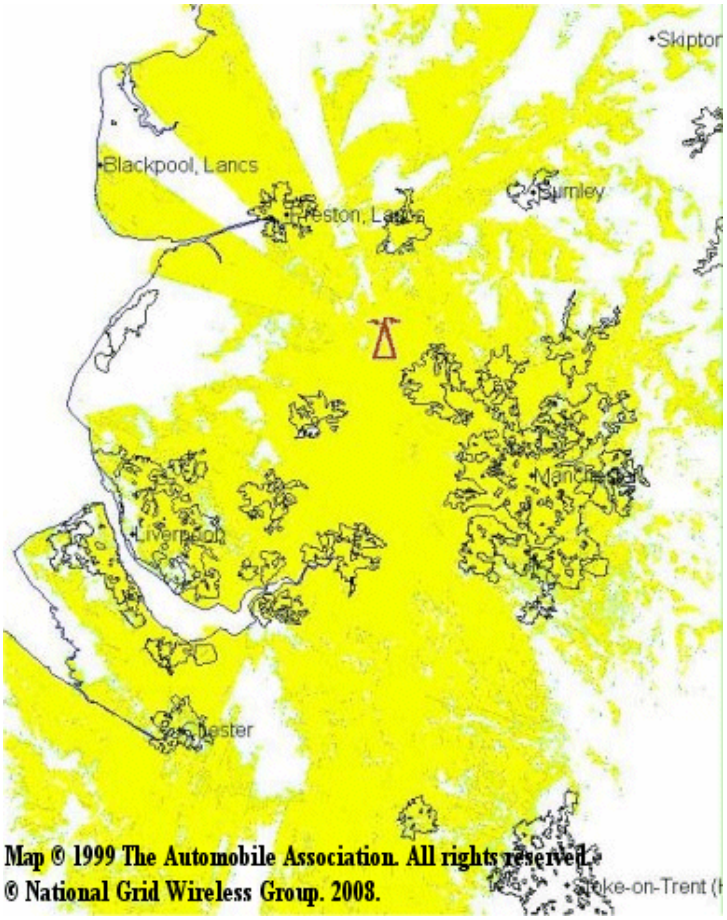
5.7 These lots are the basic building blocks of spectrum that can be awarded, which can be used individually to cover a specific city, town or community; or they can be aggregated in a number of combinations to cover regions, nations or the UK.

5.8 The list of potential lots is shown in Table 6.1. We set out examples of the potential coverage offered by individual and aggregated lots in the following paragraphs. All coverage predictions are based on a certain set of assumptions concerning the extent of protection of existing DTT multiplexes that we term the median method (unless otherwise stated), as is described later in this section.(see paragraphs 5.21-5.30)

Individual lots

5.9 An example of a large lot is channel 56 from the Winter Hill transmission site. Figure 5.1 shows that it potentially covers much of North-West England including Greater Manchester and Liverpool, with a total population of more than 2 million households. The coloured area shows the predicted coverage.

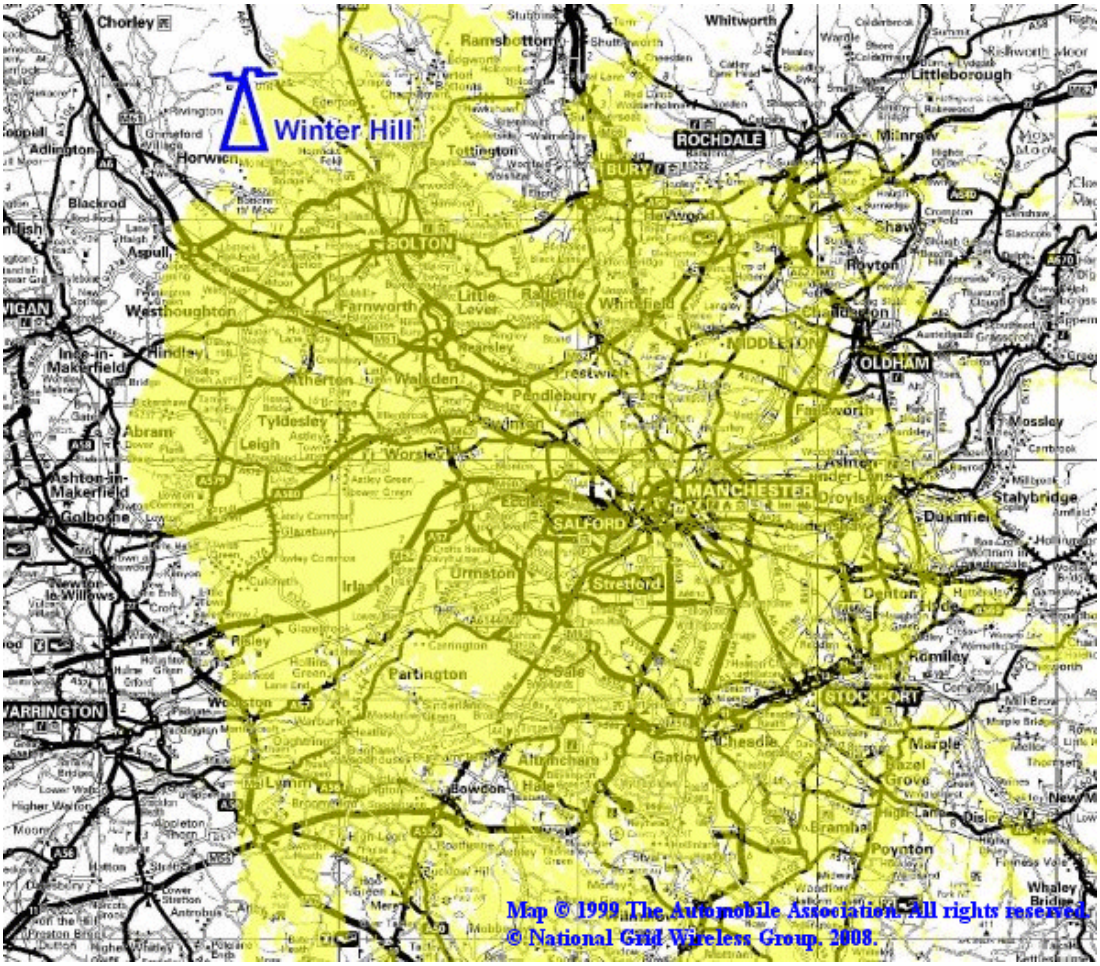
Figure 5.1 Potential coverage of large lot from Winter Hill



Source: NGW
Note: Modulation - 64QAM

5.10 An example of a medium lot is channel 57 from the same Winter Hill transmission site. Figure 5.2 shows that it potentially provides targeted, directional coverage of Manchester itself. The total population covered is smaller at about 800,000 households but is still potentially commercially significant.

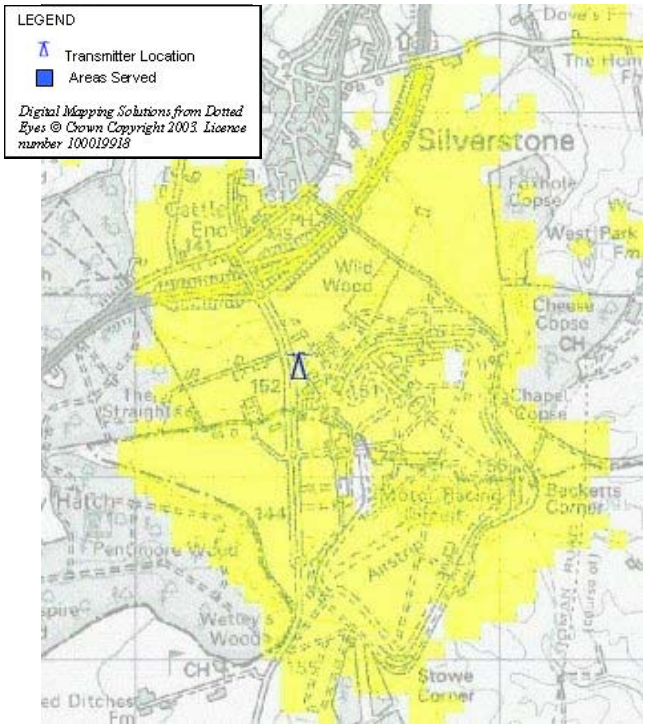
Figure 5.2 Potential coverage of medium lot from Winter Hill



Source: NGW
Note: Modulation - QPSK

5.11 An example of a small lot is channel 65 from Silverstone. Figure 5.3 shows that it potentially provides very localised coverage of Silverstone Racing Circuit. This lot could be used to provide a TV service to spectators within the racing circuit covering, for example, the F1 British Grand Prix.

Figure 5.3 Potential Coverage of Small Lot from Silverstone



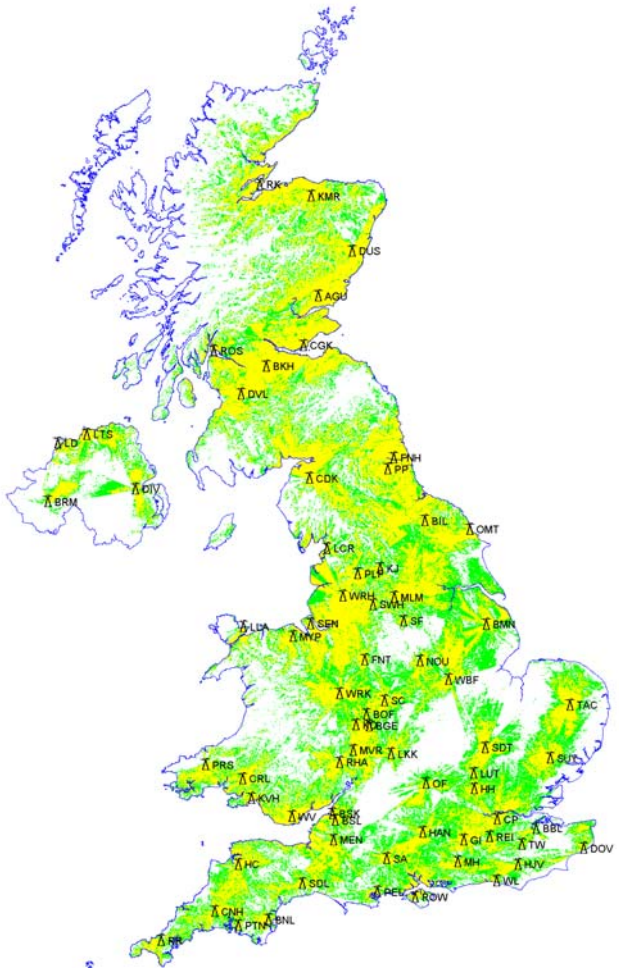
Source: NGW
Note 1: The Silverstone prediction was done using the current planning method for RTSLs, not the median method.
Note 2: Modulation - 16QAM

5.12 Individual lots offer various coverage possibilities ranging from a region to a town, city, small community, or event location. For those who want access to spectrum to serve smaller communities and events, which require more localised coverage or limited duration, there is a balance to be struck between bidding in an auction for what we would refer to as small geographical lots, and accessing the spectrum through negotiating with an operator that has or will have rights to relevant spectrum (such as the operator of an existing DTT multiplex, a new multiplex operator or the band manager). Depending on demand (which we consider later, see section 7), auctions may not represent the most appropriate means for securing optimal use of relevant spectrum. In addition, the costs of holding a potentially large number of auctions for relatively small lots where there may not be substantial competitive demand may not be proportionate. We need to consider relative potential benefits of maximising the opportunity to make spectrum available to the market via auction relative to the costs of putting lots to market in this way, within the context of our statutory duties.

Aggregation of lots

5.13 Individual lots can also be aggregated in a multitude of combinations. For example, Figure 5.4 shows the potential coverage provided by aggregating 71 large and medium lots together. This aggregation of lots would cover about 53 per cent of the UK population (14 million households) using 64QAM modulation with capacity for eight to nine video streams (or about 76 per cent using QPSK modulation with capacity for three video streams).

Figure 5.4 Potential coverage of 71 aggregated lots in the UK (64QAM = Yellow, QPSK= Green)



Source: NGW

5.14 Of the 71 lots, 4 are in Northern Ireland, 8 are in Scotland, 6 are in Wales and 53 are in England. Table 5.1 shows the potential coverage offered by aggregation of the relevant lots in each nation.

Table 5.1 Potential coverage of aggregated lots in the nations

Nation	Number of aggregated lots	Coverage (64QAM)
England	53	51 per cent
Northern Ireland	4	32 per cent
Scotland	8	79 per cent
Wales	6	52 per cent

Source: Ofcom

5.15 Many other combinations of lots are possible. For example, lots could be aggregated to provide coverage of a particular nation or region. Coverage need not be contiguous either; several city based lots could perhaps be aggregated to form a city TV network.

Question 6. What levels of coverage and aggregation are of interest to you?

Potential optimisation of interleaved spectrum

5.16 The main users of the interleaved spectrum are the existing DTT multiplexes. However there will still be gaps, or white space, in the interleaved spectrum after DSO which could be used for additional services. So far, all the work to identify potential lots for new services has assumed that the DSO frequency plan for the existing DTT multiplexes is fixed. But it is possible with a small number of adjustments to the technical details of the DSO frequency plan to release more white space, whilst still meeting the DSO coverage targets. Ofcom commissioned National Grid Wireless Ltd (NGW) and Arqiva Ltd (Arqiva) to look at potential optimisation of interleaved spectrum in Scotland and Northern Ireland respectively, as in these areas, there seemed to be some scope to do this.

5.17 NGW's study[21] indicates that five fewer channels (30, 48, 51, 52, 56) could be used for the existing DTT multiplexes in Scotland by revising the DSO plan for one main transmission site (Rumster Forest) and nine relays. If these five channels were then used for two additional new DTT multiplexes, coverage (assuming 64QAM) could be as shown in Table 5.2. Note that these coverage predictions are just examples of what could be done with the optimised spectrum.

Table 5.2 Potential coverage from optimisation of interleaved spectrum in Scotland

Multiplex	Coverage of Scotland (households)	Notes
First additional	84 per cent	Using 15 transmission sites
Second additional	52 per cent	Using Black Hill and Craigkelly only (i.e. covers Glasgow and Edinburgh)

Source: Ofcom

5.18 Comparing the coverage figures in Tables 5.1 and 5.2, we can see that potential Scotland coverage is higher if the interleaved spectrum can be optimised than through straightforward aggregation of Scottish lots. We are discussing with the operators of the existing DTT multiplexes the feasibility consequences of making any technical adjustments to the DSO plan. In addition, changes to the DSO plan may also need to be agreed internationally. Further consideration is required on the trade off between the adjustments to the DSO plan and the potential introduction of new services.

5.19 Arqiva carried out a similar optimisation of the interleaved spectrum in Northern Ireland. This study suggests that Northern Ireland coverage could improve to around 85 per cent through optimisation, compared to 32 per cent from the straightforward aggregation of lots (shown in Table 5.2). Again, this would impact upon and require changes to the DSO frequency plan. Any such changes would need to be agreed. We intend to consider this further in taking forward our plans for these awards. There would also need to be agreement between the UK and Ireland for both the new interleaved lots and the changes to the DSO plan for this to happen.

5.20 Having looked at Scotland and Northern Ireland, what are the prospects for Wales and England? Due to its geography and population distribution, it takes almost the same number of transmission sites (and thus frequencies) to cover Wales as it does

[21] *Interleaved Spectrum Planning Study. Final Report*, NGW, 30 November 2007, http://www.ofcom.org.uk/consult/condocs/ddr/statement/NGW1.pdf

to cover Scotland, which has four times the land area and twice the population. There is also the potential for interference with Ireland along the west coast of Wales, and with England in the north, east and south. The interleaved spectrum therefore will be very intensively used after DSO in Wales, with relatively little white space remaining.

5.21 We therefore consider that there is little prospect of a significant improvement in available interleaved spectrum capacity being available in Wales. In addition, DSO preparations for Wales are already far advanced (switchover starts in 2009), with DSO transmission equipment already installed or ordered. Any late amendments to these plans to improve DSO spectrum efficiency are likely to mean additional costs, having to scrap installed equipment, and possibly even the risk of delays to the DSO timetable.

5.22 The availability of interleaved spectrum in England is similar to the situation in Wales, described above. There are too many internal and external interactions for significant additional spectrum efficiency to be realised through changes to the DSO plan. Again, DSO preparations for parts of England are far advanced (Border DSO in 2008/9, Westcountry DSO in 2009, Granada DSO in 2009), and Whitehaven in Copeland has already switched over.

Caveats regarding coverage predictions

5.23 All coverage figures shown in this document have been statistically predicted by a computer model based on the same set of technical criteria and assumptions as those used for DSO DTT planning (the UK Planning Model). These include the assumptions that all households have a good quality in-group aerial at the right height and orientation. The coverage predictions are inherently optimistic because the computer model uses theoretical antenna templates that will not be matched in practice.

5.24 Actual coverage will vary depending on factors such as the real antenna characteristics, the eventual transmitter location, the achievable antenna height, the actual power and the selected channel.

5.25 The coverage predictions also assume transmissions from an antenna located at a certain height on the transmitter mast. It is not known whether there is room on the mast at this or any other height for another multiplex antenna. In practice the tops of masts are typically fully occupied. If a different site and height is used, the predicted coverage will be different.

5.26 In addition, all the analysis assumes that the use of the lots concerned will be exclusively DTT using consistent technology as deployed in the existing DTT multiplexes, and as reflected in the broadcasting industry's existing planning models. They make no provision for other services or technologies using these lots.

Impact of new DTT services on the existing DTT multiplexes

5.27 Introducing new DTT services in the interleaved spectrum could have an impact on the coverage of the existing DTT multiplexes following DSO. We need to strike the appropriate balance between the two.

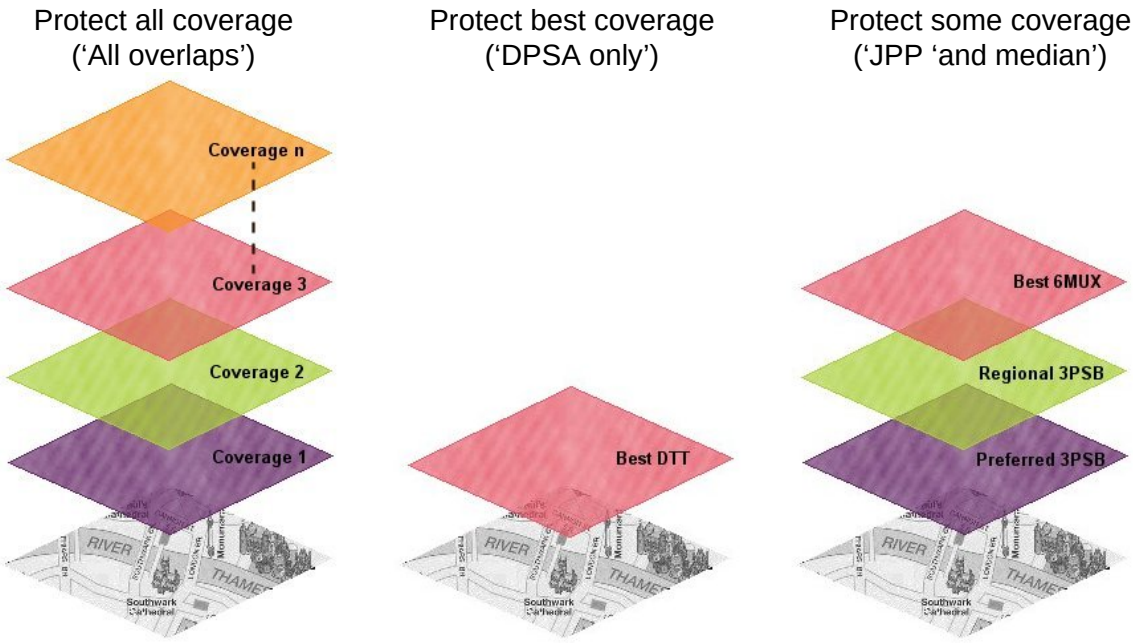
5.28 The Government wants everybody who currently received the analogue PSB services to be able to receive the PSB channels also on DTT. Ofcom has therefore placed an obligation on the operators of the PSB DTT to match the coverage of the existing analogue terrestrial networks (estimated as being 98.5 per cent of UK

households). We consider that it is important that this obligation can be achieved whatever the balance struck between existing and new DTT services. There is no equivalent coverage obligation for commercial DTT multiplexes (at DSO they are expected to be available to around 90 per cent of UK households) but we are equally mindful of the impact that any loss of the planned coverage of these services could have on viewers. We have therefore considered what is the appropriate level of protection that should be provided to existing DTT services in developing our proposals.

Protection options

5.29 In order to meet the planned coverage of DTT from the existing multiplexes after DSO, if just one DTT transmission site covers a particular location, the coverage of that transmission site should be protected. But, in any particular location, some households may, under current plans, have a choice of DTT transmission sites from which to receive existing DTT multiplexes, as there are coverage overlaps. Figure 5.5 illustrates this for a notional location where overlapping coverage from several DTT transmission sites is currently available. A household in that location could be receiving services from any one or more of the transmission sites, assuming the use of a suitable (in group) TV aerial pointing in appropriate direction(s).

Figure 5.5 Overlap coverage protection options



Source: Ofcom

5.30 In such a case of overlapping coverage, the post-DSO protection options we have considered are:

- **All overlaps** - if we protect all existing overlapping coverage from all DTT transmission sites predicted in the post-DSO plans, there will be no impact from any new DTT services using geographic interleaved spectrum on any of the households who may be currently be expected to receive the DTT multiplexes from any one or more of these sites after DSO. But, consequently, there would be fewer lots available for new services to use, affording less coverage, as the existing DTT overlaps in combination use up much of the available interleaved spectrum.

- **DPSA only** - if we protect only the coverage of the 'best' DTT transmission site (referred to as the Digital Preferred Service Area ('DPSA') in NGW's original study for 71 transmission sites), households who are currently expecting to receive services from other overlap transmission sites may no longer have this choice. Some households who would only receive their DTT services from an overlap transmission site may have to realign and/or replace their television aerials to tune to the 'best' site. The 'best' site is taken to mean the transmission site offering at least services from the three multiplexes operated by public service broadcasters ('3PSB coverage') together with the greatest number of the three existing commercial multiplexes in the area concerned. This option would maximise the number and coverage of geographic interleaved lots that would then be available for new DTT services.

- **JPP** - The DSO Joint Planning Project ('JPP'[22]) proposed protecting a total of three overlap coverages with a small fixed increase (0.5dB) in interference. This allows a few new services to be introduced in the interleaved spectrum with little impact on existing DTT coverage. The three protected coverages are:

  - DPSA – refers to the 'best' DTT transmission sites as per the DPSA only option, as described above.

  - Analogue preferred service area ('APSA') – refers to coverage from the transmission sites currently offering the best analogue service to a household. This protects at least part of the coverage of all 1,154 existing analogue transmission sites, thereby moderating the potential disruption to existing TV aerial installations where the DPSA and the APSA do not align. The APSA is determined using a model that takes into account analogue signal strength, availability of Five, and the sequence in which the analogue transmissions were switched on, amongst other factors. The relevance of APSA is that it models where existing aerials are pointed and therefore minimises disruption to existing aerials which is not taken in to account by DPSA.

  - Correct national/regional service – protecting this ensures that all households located in England have a protected 3PSB English service, and similarly for all Welsh, Scottish households. It will also protect the correct ITV/BBC region.

- **Median** – this option protects the DPSA and APSA overlap coverages as with JPP above, but with a higher variable increase (more than 1dB) in interference which allows more new services to be introduced in the interleaved spectrum. The impact on the overlaps in planned DTT coverage is a little higher than the protection offered by the JPP option, while providing a limited reduction in the usability of the geographical interleaved lots to that offered by the DPSA only option.

Analysis of protection options

5.31 The JPP planners do not support the 'All overlaps' option, indicating instead support for the JPP option. We, too, consider that this level of protection does not represent the appropriate balance between existing and new DTT services, and so we do not consider it further.

[22] JPP comprises BBC, Arqiva, NGW, Digital 3&4 Ltd and SDN Ltd, and is chaired by Ofcom. The group was established to provide a consistent approach to planning the introduction of digital terrestrial broadcasting in the UK.

5.32 We have analysed the three remaining protection options (DPSA only, JPP and median) by comparing the:

- Potential impact on the DTT multiplex overlap coverage and associated remedial costs for each option of an aggregated network of ten interleaved geographical lots as an illustrative example.

- Potential coverage and economic value of this illustrative aggregated network of ten lots for each option.

Potential impact on DTT multiplex overlap coverage

5.33 Table 5.3 shows, for each option, the potential impact of an illustrative network of ten interleaved geographical lots on DTT multiplex overlap coverage post-DSO in terms of the number of households who would potentially lose reception of their chosen DTT transmission site, and thus might need to reposition and/or replace their TV aerials to receive from alternative DTT transmission sites. This illustrative network would cover around half of the total UK households which may be served by new DTT services using this spectrum.

Table 5.3 Impact on DTT multiplex overlap coverage

	DPSA Only	Median	JPP[23]
Number of households potentially requiring aerial repositioning or replacement	10,000	5,000	600
Aerial replacement cost (£150 per household)	£1,500k	£750k	£90k

Source: Ofcom

5.34 The aerials of around 10,000 households affected by this notional network of 10 transmission sites may need to be repositioned or replaced under the DPSA option in order to secure the single best set of signals. Under the median option, which offers a higher degree of protection to existing DTT overlap coverage, the number of households needing to reposition aerials would fall to around 5,000. The number of households needing to reposition aerials would fall to fewer than 600 under the JPP option, which offers the most protection to DTT multiplex overlap coverage. On this basis, the DPSA option would require around 5,000 more aerials to be replaced or repositioned relative to the median option. Assuming an aerial replacement cost of £150 per household[24], this would equate to an additional cost of less than £1 million.

5.35 NGW's predictions indicate that many hundreds of thousands of households would in theory be in DTT multiplex overlap coverage areas after DSO for all three options. But predictions cannot tell us how many of these households actually receive signals from overlap DTT multiplexes and hence could be affected, in practice, by new DTT transmissions after DSO. We have used data from the BARB establishment survey to provide an estimate of the number of household which receive more than one ITV

[23] It has not been possible to implement protection of the correct national/regional coverage for the JPP option. Initial indications are that this would further increase protection of existing DTT overlap i.e. even fewer households would need to replace aerials, and consequently coverage of new DTT services would be even lower.

[24] Digital UK FAQs at http://www.digitaluk.co.uk/faqs/how#a_id1448 says "Installation of a standard new roof aerial is likely to cost between £60 and £180. Additional sockets cost around £45. Upgrades to communal aerial systems may result in increased service charges"

region. This number is significantly lower than that predicted by the NGW predictions alone. Annex 5 provides further details.

Potential coverage of new DTT services

5.36 Table 5.4 shows, for each option, the potential coverage of the same aggregated network of ten interleaved geographical lots assuming they are used for new DTT services with 64QAM modulation.

Table 5.4 Potential coverage of aggregated network of ten lots

	DPSA Only	Median	JPP[23]
Potential coverage of aggregated network of ten interleaved lots in households	7.3m	7.0m	5.0m

Source: Ofcom

5.37 The table indicates that the JPP option, which offers more rigorous protection of the possible level of choice within overlap areas for DTT services, would mean that significantly fewer households would benefit from new services that might be provided through the interleaved spectrum. The value of these new services is subject to considerable uncertainty. It is not clear for example which service might be provided, although there is a high likelihood it will be some form of broadcasting service.

5.38 An illustration of the relative costs and benefits of each option can in the first instance therefore be gauged by reference to the minimum benefits that new services would bring in order to offset aerial replacement costs. 'For the illustrative network of ten interleaved geographic lots as set out above, this value would be £0.21 per household. That is, were new services to produce a benefit to each household of £0.21, this benefit would be sufficient to offset aerial replacement costs under each of the options. Table 5.5 illustrates this.

Table 5.5 Illustration of the relative costs and benefits of DPSA, median and JPP options

	DPSA Only	Median	JPP[23]
Aerial replacement cost	£1,500k	£750k	£90k
Illustrative benefits of new services, (21p per household)	£1,533k	£1,470k	£1,050k
Net benefit / (cost)	£33k	£720k	£960k

Source: Ofcom

5.39 Consumer research conducted for our 2006 DDR consultation[25] estimated that households would be willing to pay an average price of around £14 per year for 1 local TV channel. Over ten years, assuming a declining valuation per year, this might be represented by an equivalent one off payment of about £55. Our later tranche of consumer research conducted for the DDR statement found that 39 per cent of respondents would be likely to pay a one-off £100 to buy and install a new aerial in order to access eight new standard definition channels.

5.40 These numbers suggest that the overall benefits of new services can be expected to exceed comfortably costs in terms of aerial replacements and so produce overall

[25] http://www.ofcom.org.uk/consult/condocs/ddr/

benefits for households. We could also use these numbers to illustrate the relative benefits of the options against each other and so inform our choice of one option over another.

5.41 Hence, in order purely to illustrate the relative costs and benefits of the different options above, we could assume a one-off benefit per household of new interleaved services at a conservatively low level, say around £40 per household, over the lifetime of the service. Using this illustrative value and the coverage figures above gives an illustrative scale of the consumer benefit of the new services under each of the options for the notional network illustrated above. Table 5.6 illustrates this.

Table 5.6 Illustration of scale of consumer benefit of DPSA, median and JPP options

	DPSA Only	Median	JPP[23]
Aerial replacement cost	£1,500k	£750k	£90k
Illustrative benefits of new services, (£40 per household)	£292m	£280m	£200m
Net benefit of new services / (cost)	£290m	£279m	£200m

Source: Ofcom

5.42 In sum, the JPP option reduces the potential availability of new services by around 2 million households, with an illustrative loss in value to consumers of at least £80 million, while saving only £0.7 million to £1.4 million in aerial replacement costs compared with the median and DPSA options. Although some greater possibility of choice of DTT service exists within overlap areas with this option, it is unlikely to justify the loss in benefits from new services.

5.43 There is much less difference between the DPSA and median options. Relative to the median option, the DPSA option would offer perhaps £12 million of extra benefit from new services and involve less than £1 million additional aerial repositioning costs. However the benefits of both options greatly offset any aerial replacement or repositioning costs.

5.44 Overall, given the likely coverage figures under each option and the relatively small difference in aerial replacement costs between DPSA only and the median options, and the difference in economic value of the DDR geographic interleaved spectrum between these two options, a purely economic assessment would marginally favour the DPSA only option. However we consider that there are other factors that may tip the balance more towards the median option.

Other factors

5.45 As detailed in the original NGW interleaved study, the DPSA only option does not protect about 100 of the existing analogue relays i.e. the DPSA assigned coverage for these relays is zero, even though it is estimated that they are being used by 170,000 households now for analogue TV (i.e. the total APSA coverage of these 100 relays). Also, there are additional relay sites where the DPSA is much less than the APSA. DSO policy is to switch over all 1,154 analogue relays to digital, in part to cater for existing analogue aerials as far as possible, as well as to achieve the 98.5 per cent PSB coverage target. As these relays are required to switch over to digital, we consider it appropriate to protect them from potential interference from new DTT services using geographic interleaved spectrum. This is why the median and JPP options protect the APSA as well.

5.46 The DPSA only option also does not take account of national or regional borders as the DPSA is based on the 'best' DTT transmissions regardless of nation or region. For example the DPSA planning would assign 150,000 households in England to the Welsh transmission sites at Moel-y-Parc and Wenvoe. In theory, this means that any transmissions from a transmission site in England that these 150,000 households currently receive could be subject to interference by new DTT services using geographic interleaved spectrum, since the DPSA only protects the overlap transmissions from the transmission site in Wales (and not the transmissions from the transmission site in England). So a proportion of these 150,000 households in England may receive transmissions from a transmission site in Wales with the 'incorrect' national/regional programmes (such as local news) due to interference. However the JPP option specifies protection of the correct national and regional service (though it has not been possible to implement this in this example). We consider that there is an argument for additionally protecting at least the correct national service.

Review of protection options

5.47 The JPP option offers stronger protection for DTT choice of services in DTT overlap areas, especially with regards to existing aerials pointing at relays and the correct national or regional service. However, this option also offers lower potential coverage for new DTT services. The economic impacts of losing so much usable interleaved spectrum could be relatively significant. The analysis suggests that the JPP option is very unlikely to yield the optimal use of the spectrum concerned.

5.48 The DPSA only option maximises the economic value and potential coverage of new DTT services relative to the alternatives examined. But, as detailed in the NGW study which we published with the DDR statement, it does not protect 100 existing analogue relays, or the correct national or regional service. It also has the largest potential impact on DTT overlap coverage, with about 10,000 households in the illustrative network of ten sites that we analysed (all of which would be in overlap areas) potentially requiring replacement or repositioning of their TV aerials,

5.49 The median option offers significantly more potential coverage for new DTT services relative to the JPP option, although that access to new DTT services would still be materially reduced by around 300,000 households in our example of a ten site network. Equally this option has less of an impact on DTT overlap coverage relative to the DPSA only option.

5.50 The choice between the DPSA only and median options is finely balanced. On the one hand, under the DPSA only option, many more households may receive new services than would be required to replace aerials, such that the attendant financial benefits may significantly outweigh the extra aerial replacement costs.

5.51 On the other hand, the median option would afford a degree of protection to all 1,100 or so transmission sites that will be switched over to digital, including the 100 or so relays that are not protected by the DPSA option. Protection of the correct national service could also be added. The value of these benefits is more difficult to quantify and therefore set against the value of new services offered via the interleaved spectrum. However, we consider they are important, and could be greater than the value of access to new services to more households that would be offered by the DPSA only option. On balance, we favour the median option.

5.52 These proposals will also apply to other uses of interleaved spectrum. In particular the adoption of the median option on a UK-wide basis is likely, in some cases, to

increase the availability of spectrum for PMSE users in areas of overlapping coverage. Further details of this will be published in the consultation on the band manager award, later in the summer.

Conclusions

5.53 The studies we commissioned have shown that geographic interleaved spectrum can be used to provide new DTT services with coverage ranging from single communities to (via aggregation) regions, nations and the much of the UK.

5.54 We considered various options for the protection of existing DTT multiplexes from new DTT services using geographic interleaved spectrum. We consider that the median option offers the best balance between maximising the economic value of the geographic interleaved spectrum and minimising the potential disruption to overlap coverage of the existing DTT services, and therefore propose this form the basis of the planning for new services.

Question 7. Do you agree that the median option offers an acceptable balance between protecting reception of DTT services and maximising new DTT services using geographic interleaved lots?

Section 6

Spectrum packaging

Introduction and summary

6.1 In this section we consider the lots to be awarded and the timing of the awards. We

- recap what we said in the DDR statement;
- describe the location and channel for each lot that we might award;
- propose a candidate list of sites where lots may be available;
- discuss the sequencing and timing of the awards;
- discuss the need for evidence of demand for the lots to be auctioned; and
- describe how we propose to assess evidence of demand arising from expressions of interest.

What we said in the DDR statement

6.2 Our main conclusions on these awards were:

- We would award one or two frequency channels at a number of transmission sites, suitable but not reserved for local TV.
- The channels would be 'in group'[26] for a given coverage area from a specific transmission site, able to permit broadcasts at sufficient power to be received by most households in that area.
- We would package the spectrum in geographic lots, based on main transmission sites serving major towns and cities and in areas where local TV operators were already licensed to provide an analogue service. We gave an indicative list of 25 possible locations across the UK where we expected that interest would justify offering such lots. We were willing to consider other locations if there was persuasive evidence of demand. At our January 2008 stakeholder meeting for local TV interests we invited feedback on this point (see paragraph 6.10).
- The geographic interleaved spectrum would be awarded by auction to the highest bidder.
- We would aim to conduct the awards in each ITV region at least a year before DSO in that region, where possible, to give successful bidders time to develop their operations before spectrum became available for use.
- The first lots would be awarded in late 2008 for those transmission sites (Caldbeck, Winter Hill and Wenvoe) which would provide coverage for areas where existing RTSL operators needed, prior to DSO, sufficient clarity about their options for future spectrum access.

[26] 'In group' means that particular channels will be within the antenna frequency range of the post-DSO DTT frequency channels from transmission sites at particular locations.

- The remaining geographic interleaved spectrum would be awarded later.

- Awarding geographic interleaved spectrum sequentially might make it difficult to acquire a number of lots (create an aggregation risk) for an operator that wished to offer services in more than one geographic area at once. We would consider this when deciding whether to award the remaining channels sequentially or simultaneously.

Assessing where and what frequency channels we should auction

6.3 We set out here our approach to assessing which channels and types of coverage should be offered for award, in which locations, and how many channels at each location. We do this with reference to the types of lots that could be available for sale and the potential demand for spectrum. We discuss later our proposed approach to the sequencing and timing of awards (paragraphs 6.26ff).

Types of lots

6.4 As we described in section 5, the availability and coverage of interleaved spectrum will vary by transmission site and channel. A number of sites will have channels available that provide good, all round geographical coverage, and are likely to be suitable for aggregation with others or on a standalone regional basis. We refer to these as 'large' lots. Some channels will provide more targeted or directional coverage, so offering the possibility of smaller city or town coverage but still potentially commercially significant coverage of many households. We refer to these as 'medium' lots. Other sites may offer channels with smaller coverage, particularly where these happen to be relays rather than main transmission sites. Transmission from such sites might be suitable for local, event or community broadcasting. We refer to these as 'small' lots. Many sites will offer a number of channels, meaning that some combination of large, medium and small lots may be available at any one site.

6.5 The number of lots that is potentially available for auction and the relative mix of these in terms of 'large', 'medium' and 'small' lots will be determined by demand and technical considerations and constraints.

Alternative ways to access the interleaved spectrum

6.6 There are a number of options for obtaining rights to using spectrum, besides acquiring them through a spectrum award. It would be possible to access spectrum through bilateral negotiation with the band manager[27]. It would also be possible to acquire rights through spectrum trading with licensees who hold spectrum attractive to others. An existing or new multiplex operator would also be able to provide capacity to broadcasters. In deciding how best to obtain rights to use spectrum interested parties will need to compare the costs and benefits of the alternatives. Overall, we consider that the relative potential benefits of maximising the opportunity to make lots available to the market via auction need to weighed against the costs of putting lots to market and the costs involved in bidding for such lots. If there is little demand for spectrum in a particular locality (so that it has a low opportunity cost) or the lot is only required for a short period of time for a specific event, the auction process may prove inefficient and unnecessary, particularly if access to sufficient suitable interleaved spectrum could be acquired through other means.

[27] We intend to publish a separate consultation in relation to the spectrum to be awarded to a band manager later in the summer.

6.7 In general we consider that what we refer to as 'small' lots would not be included in the spectrum awards. We describe below (paragraphs 6.51ff) the process we propose for assessing demand for particular transmission sites for inclusion in the award. In that process it will be open to interested parties to make a case for including particular 'small' lots in the award.

Candidate locations and channels for award

6.8 In the DDR statement we set out an indicative list of 25 locations and said that we anticipated auctioning lots for these locations. The list took into account the level of population coverage that might be required for broadcasting and areas where there were existing RTSLs. We said we would consider adding further locations if there was evidence of demand. In aggregate, these 25 locations could, depending on the compression technology adopted, provide DTT broadcasting coverage of around half or more of UK households. Most of the lots at these sites would be 'large' lots.

6.9 NGW work, also published in December 2007[28], provided coverage data for a set of frequency channels at 71 transmission sites (including the 25 indicative locations). This coverage data was based on the DPSA definition of protection of DTT services; changes to the protection of DTT will therefore, as explained in section 5, alter coverage.

6.10 We held a stakeholder event for parties specifically interested in local TV on 14 January 2008, where we invited participants to indicate if and where they might be interested in acquiring lots. This revealed interest in providing broadcasting services in 18 areas. Some of these were linked to a particular location (ten at locations included in NGW's work, eight elsewhere). Others were interested in providing broadcasting services over a wider area and so implied an interest in aggregating 'large' lots.

6.11 The Crown Dependencies are interested in lots being made available either through this award (Guernsey and Jersey) or through an independent award (the Isle of Man).

6.12 On the basis of the above, we have compiled a list of candidate transmission sites, each of which could form the basis for one or more lots. In Table 6.1 these are listed as follows:

- 25 sites listed in the DDR statement (including existing RTSLs), (rows 1 to 25);
- the 46 sites remaining of the 71 sites identified in the NGW study (rows 26 to 71);
- eight transmitter sites, additional to the list of 71, identified following the January 2007 stakeholder event, (rows 72 to 79); and
- two sites in respect of Crown Dependencies (Guernsey and Jersey, and Isle of Man), (rows 80 and 81).

[28] *Interleaved Spectrum Planning Study Final Report*, NGW, 30 November 2007, http://www.ofcom.org.uk/consult/condocs/ddr/statement/NGW1.pdf

Table 6.1 Indicative list of transmission sites and frequency channels

No.	Site	Indicative channels	Relevant area	No.	Site	Indicative channels	Relevant area
1	Caldbeck	21 and 48	Carlisle	42	Bristol Kings Weston	30	Bristol relay
2	Winter Hill	57 56 and 60	Manchester/Liverpool.	43	Rosemarkie	52	Inverness
3	Wenvoe	30 and 51[29]	Cardiff	44	Rosneath VP	48	Greenock
4	Mendip	55 and 59[29]	Glastonbury/Somerset	45	Knockmore	56	Elgin
5	Craigkelly	52 and 30	Edinburgh	46	Angus	48	Dundee
6	Black Hill	51 and 48	Glasgow	47	Durris	30	Aberdeen
7	Oxford	49 and 29	Oxford	48	Darvel	30	Ayr
8	Waltham	55 and 59	Leicester	49	Luton	45	Luton
9	Belmont	21 and 23	Grimsby/E. Yorkshire	50	Olivers Mount	56	Scarborough
10	The Wrekin	48 and 29	Shrewsbury/Telford	51	Sheffield	26	Sheffield
11	Ridge Hill	30 and 23	Ross-on-Wye/Hereford	52	Nottingham	62	Nottingham
12	Emley Moor	45 and 56	Leeds	53	Kidderminster	56	Kidderminster
13	Sutton Coldfield	51 and 29	Birmingham	54	Lark Stoke	48	Stratford upon Avon
14	Sandy Heath	49 and 23	Bedfordshire	55	Brierley Hill	56	Greater Birmingham relay
15	Sudbury	49 and 57	Suffolk	56	Keighley	56	Keighley
16	Tacolneston	57 and 49	Norwich	57	Malvern	51	Malvern
17	Hannington	43 and 49	Basingstoke	58	Bromsgrove	29	Bromsgrove
18	Rowridge	29 and 30	Southampton/Portsmouth	59	Fenton	29	Stoke on Trent
19	Crystal Palace	29 and 42	London	60	Poole	50	Poole
20	Heathfield	54 and 45	East Sussex	61	Guildford	54	Guildford
21	Dover	57 and 49	Dover	62	Hemel Hempstead	49	Hemel Hempstead
22	Bilsdale	24 and 21	Middlesbrough	63	Midhurst	46	West Sussex
23	Pontop Pike	56 and 51	Newcastle	64	Salisbury	49	Salisbury
24	Londonderry	22 and 52	Londonderry NI	65	Reigate	51	Reigate
25	Divis	30 and 56	Belfast NI	66	Whitehawk Hill	54	Brighton
				67	Tunbridge Wells	51	Tunbridge Wells
26	Beacon Hill	49	Torquay	68	Bluebell Hill	56	Mid Kent
27	Stockland Hill	30	Honiton/Exeter	69	Limavady	56	North West of NI
28	Huntshaw Cross	51	Barnstaple	70	Brougher Mountain	30	Omagh NI
29	Plympton	49	Plymouth	71	Fenham	30	Newcastle relay
30	Redruth	55	Cornwall				
31	Caradon Hill	30	Devon	72	Selkirk	56	Borders
32	Presely	30	South West Wales	73	Bressay	30	Shetland Islands
33	Carmel	52	South West Wales	74	Keelylang Hill	48	Orkney
34	Llanddona	51	Anglesey	75	Rumster Forest	52	Wick/Thurso
35	Lancaster	30	Lancaster	76	Eitshal	30	Isle of Lewis
36	Saddleworth	43	Saddleworth	77	Tay Bridge	51	Dundee relay
37	Storeton	30	Birkenhead/Liverpool	78	Perth	30	Perth
38	Pendle Forest	30	Burnley	79	Balgownie	51	Aberdeen relay
39	Moel y Parc	30	North East Wales				
40	Kilvey Hill	30	Swansea	80	Isle of Man	51	Douglas Isle of Man
41	Bristol Ilchester Crescent	51	Bristol relay	81	Jersey and Guernsey	48	Jersey and Guernsey

[29] Some frequencies are currently expected to remain in use for DTT services for a temporary period after DSO at certain transmitters. This is anticipated to involve channels 30 and 51at Wenvoe and channel 59 at Mendip. It is anticipated that these frequencies would be available from May 2011. A temporary frequency will be made available capable of providing coverage equivalent to that achieved by the existing Cardiff RTSL in analogue form.

Deciding which candidate locations and channels to include in the award

6.13 Our approach to spectrum packaging is to reflect potential demand. We will award spectrum where there is a reasonable expectation of demand and in a way that reflects as far as possible the likely geographic pattern of demand. The consideration of putting any set of lots to market by auction will need to take into account the optimal use of the spectrum, be consistent with our statutory duties and proportionate, including a consideration of all the costs of conducting and participating in auctions.

6.14 As noted in paragraphs 4.20 to 4.37, we undertook further stakeholder research in order to understand potential uses for geographic interleaved spectrum. This pointed to potential demand for this spectrum for broadcasting applications both at a local level and for aggregating lots in order to provide regional, national or sub-UK services.

6.15 The indicative list of 25 sites in the DDR statement would be suitable for providing services at a number of locations or over a wide area, as well as for local coverage. We are proposing to offer mainly large lots at these sites in a combined award that would allow aggregation of lots. We are prepared to add to the list if, in response to this consultation, a persuasive case is made that further sites would be suitable for aggregation. The award of spectrum at sites on the list as it stands is confirmed and we would only consider removing sites if responses to this consultation demonstrate convincingly that there is unlikely to be demand for a particular site.

6.16 As we said in the DDR statement, we will award spectrum first at those transmission sites that provide coverage for areas where existing RTSL operators need, prior to DSO, sufficient clarity about their options for future spectrum access. These are Caldbeck, Winter Hill and Wenvoe.

6.17 It is generally possible to offer two or more channels at any one site. Doing so could allow more than one type of local application (e.g. broadcasting and non-broadcasting). At Winter Hill, for example, we have also identified channels that could allow Manchester and Liverpool to be covered separately. We consider that there may be sufficient demand for use of second channels at the 25 sites to offer them for award - as well as a channel at each of the other 56 sites on the table above.

6.18 The full list of 81 sites in the table above could be included in the award. However, we consider that demand may be less certain for sites not included in the list of 25 in the DDR statement. It may be the case, for example, that funding possibilities for more local applications only become clearer where they are closer to the possibility of being launched, as determined by the DSO timetable. It might also be the case that interest emerges following the roll out of other successful new broadcasters, or non-broadcasting applications (such as local WiMAX) as a result of future developments during the DSO period.

6.19 For these reasons we are proposing to include sites for award on the basis of evidence of demand, demonstrated by expressions of interest. As mentioned above, the need for expressions of interest will not apply to the early award of Caldbeck, Winter Hill and Wenvoe or to the award of first channels at the 25 indicative sites. We set out our approach to expressions of interest in paragraphs 6.50ff. Some of the expressions of interest received to date have not been fully developed and we may seek further information from those who submitted them.

Further work on coverage of the proposed lots

6.20 NGW's coverage predictions for the 71 transmission sites mentioned in paragraph 6.9 above, were done on the basis of the DPSA definition of coverage. In section 5, we explain that we have considered different options for protecting existing DTT services and propose the median approach. We have asked NGW to do further analysis of predicted coverage using the median approach for the 81 sites in the table above, which we will publish in due course.

6.21 NGW will consider each channel and location in isolation, such that the coverage predictions for example do not take into account effects and interactions from any possible new neighbouring channel usage. It may be necessary, when considering which lots are offered to market, to amend or reconsider the channel offered from a particular transmission site in order to optimise possible outcomes.

Sequencing and timing of the awards

6.22 A fundamental question in auction design, where we have a number of channels or lots to award, is whether they should be awarded in a series of sequential awards or in one award, with the spectrum lots awarded simultaneously.

6.23 Simultaneous awards generally work more efficiently where lots are close substitutes and/or complements. They can be designed with a number of rounds that allow bidders to switch between lots from round to round as prices change, so allowing substitution between lots. They can also allow bidders to bid for a number of lots in the same round, thus potentially easing the aggregation risk where lots are complements. The extent to which risks are ameliorated will depend on the auction design chosen.

6.24 However, sequential awards are not always unattractive. They are likely to work successfully where the spectrum lots on offer are not so closely related, such that they are not strong substitutes or complements for each other, e.g. the geographic coverage of lots might limit the extent of any common business case, or other constraints (such as incumbent use) might mean that lots are available at times for new uses. Sequential awards can also be appropriate where there is a hierarchy of demand between lots across all bidders, e.g. where one lot is an inferior substitute for the other, or where demand for one lot from some bidders is dependent on buying another but not vice versa. In these cases, if the more important lot is auctioned first, substitution and aggregation risk should be modest.

6.25 Sequential approaches can also have significant advantages by avoiding excessive complexity and bringing spectrum to market more quickly. This can have significant advantages for citizens and consumers by encouraging entry and helping to get spectrum into use. They may also be simpler and so facilitate participation and reduce administrative costs for all parties.

Our approach to sequencing and timing of the awards

6.26 As set out in section 4 there are a number of potential uses for the geographic interleaved spectrum, and these might vary according to location and the size of coverage required for a particular application and the coverage available from frequencies at particular locations.

6.27 In determining whether to hold a series of awards or a single award we have considered the interests of two broad sets of users:

- Users wanting to provide services in a particular defined locality.

  These users are likely to want 'medium' or 'small' spectrum lots. They may like us to award the relevant frequency some time ahead of DSO in order to allow them to develop their operational and associated business plans. But they may not want the timing to be so far ahead that they are unable to develop credible business plans that would allow them to put in place any financial backing they might need. Without adequate financial guarantees they might be unwilling to commit themselves to acquiring spectrum in an early award.

  These considerations are particularly likely to be applicable in the case of smaller, non-commercial or community local TV. These may be reliant on some form of public funding and uncertainty concerning this is likely to be greater where the period between the need to obtain spectrum and its possibility for use as determined by DSO is greater.

  Given that we are committed to maximising possibilities for all interested parties to have an opportunity to purchase spectrum through auction, these considerations would – all other things being equal - point us to holding a series of awards such that relevant lots were auctioned closer to their corresponding dates for DSO.

- Users wanting to provide services in a number of localities or on a regional or national or sub-UK basis.

  These users are likely to want mainly 'large' lots. A key consideration for them is likely to be the desirability of obtaining, in one award, all the spectrum they need to create the geographic coverage they require. They are likely to want to resolve any uncertainty over obtaining necessary spectrum sooner rather than later. For example a bidder interested in a regional or sub-UK multiplex or multiplex covering Scotland might wish to bid for all the lots that are needed for such services at the same time. The success of their business plans might rely on providing services in all or most of the locations they have identified.

  A sequence of awards over time would present the risk that they would obtain only some of the spectrum lots they need. We referred in the DDR statement to this 'aggregation risk' as being a particular concern when the values of different geographic lots are potentially interdependent with each other.

6.28 These considerations point in different directions for the sequencing and timing of the spectrum awards. The aggregation risk points to a simultaneous single award, at least of 'large' spectrum lots – i.e. those lots most suited to being aggregated. Given that bidders interested in obtaining large lots are likely to want to resolve any uncertainty over obtaining them earlier rather than later, and in line with our target of awarding spectrum with the minimum delay possible.

6.29 On the other hand, interest in more local use and the particular uncertainties around funding for smaller operations point to some form of sequential award process that appropriately takes into account these issues without giving such operators undue advantage.

6.30 One approach to uncertainties or difficulties regarding funding might be to allow bidders to make phased payments rather than a one off payment. We discussed this in the DDR statement. Phased payments retain a clear auction process and a good degree of competition between different uses. But there are significant drawbacks in

this approach in that it introduces a credit risk for Ofcom. It could also represent an implicit subsidy to the cost of capital. Moreover this approach would not address all of the concerns raised by small operators, which include difficulties in securing funding far in advance of DSO.

6.31 An alternative approach would be to hold a sequential series of awards of medium (and possibly some small) spectrum lots in step with DSO. We would conduct these awards, where possible, at least a year before DSO. This would give successful bidders time both to secure financing and to develop their operations before spectrum becomes available for use. It would also go some way to meeting concerns from small operators.

6.32 In deciding the timing of award we need to bear in mind the position of some existing RTSLs who cannot transmit in analogue after DSO in their region but might be unable to acquire, sufficiently in advance of DSO, a frequency channel enabling digital transmission. The affected operators are Carlisle TV (the Caldbeck transmission site switches between April and June 2009), Channel M in Manchester (the Winter Hill transmission site switches between October and December 2009) and Capital TV in Cardiff (the Wenvoe transmission site switches between January and March 2010).

Options for sequencing and timing of awards

6.33 We have identified three basic options for the sequencing and timing of the awards:

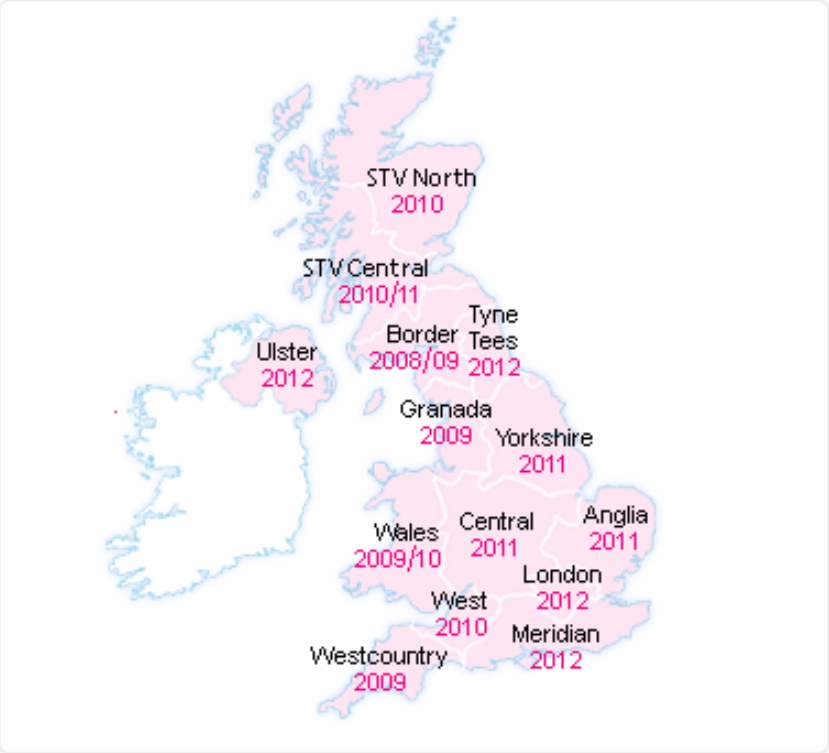
Option 1 a single combined award of all available lots as soon as practicable;

Option 2 an award of medium lots for Caldbeck, Winter Hill and Wenvoe in late 2008 or early 2009, followed by a single combined award of all remaining lots (large, medium and small) as soon as practicable; and

Option 3 a phased approach: an award of medium lots for Caldbeck, Winter Hill and Wenvoe in late 2008 or early 2009; a single combined award as early as practicable of all large lots; and, awards linked to the DSO timetable for all remaining lots.

6.34 Figure 6.1 summarises the timetable for DSO by region. A refined list by location is available at Annex 6.

Figure 6.1 DSO timetable by region



Source: Digital UK

6.35 Option 1 would address the aggregation risk. It would also give all three existing RTSL operators faced with early DSO the opportunity to obtain the spectrum they need in good time - but only if we could hold the award before early 2009. Given the preparation we and stakeholders need for such an award there is a significant risk that this would not be possible.

6.36 A single combined award later in 2009 might be more realistic but would not give much or any time for those particular RTSL operators to obtain geographic interleaved spectrum in advance of DSO. This issue could in principle be addressed by extending the duration of the RTSLs and allowing digital broadcasting until the relevant lots are awarded. But this approach could also extend uncertainty for the RTSL operators concerning their eventual acquisition or otherwise of lots in the 2009 award.

6.37 Furthermore, the timing of an award in late 2009 would perhaps be too early for those with an interest only in medium or small lots in areas where DSO is planned for significantly later.

6.38 Option 2, a variant of the first, would explicitly meets the needs of existing RTSL operators faced with early DSO. It also substantially addresses the aggregation risk by awarding all remaining spectrum at the same time, though not eliminating it in respect of the first three locations. But it shares with option 1 the problems arising from awarding spectrum that might be used by smaller organisations two or three years in advance of DSO in some areas.

6.39 It follows that neither of the first two options in our view meets satisfactorily all the points that we need to address in the sequence and timing of awards.

6.40 Option 3 – a phased approach – would be a more appropriate response to the needs both of RTSLs faced with early DSO (initial phase: early award for Caldbeck, Winter Hill and Wenvoe in 2008 or early 2009) and of those potential entrants with local interests who would, prefer an award no more than a year or so before DSO, by structuring some awards around the DSO timetable after 2009. It also substantially addresses the aggregation risk, by awarding through a simultaneous 'combined' auction large lots that are likely to appeal to those operators interested in wider geographic coverage at regional or national or sub-UK levels. This simultaneous award would release to the market a substantial amount of spectrum that could bring benefits to operators and their customers shortly after the award of spectrum suitable for national multiplexes in the cleared DDR auction.

6.41 This approach also provides equal opportunity for a disparate set of bidders to participate in auction. Bidders interested in purchasing 'large' lots suitable for aggregation will have the opportunity to compete for these on an equal footing in a combined award, with the outcome determined by those who value these lots most. The phased auctions will also be open to all and particularly provide an opportunity for bidders interested in 'medium' or 'small' lots to participate. Moreover the phased approach provides an opportunity for smaller operators to arrange funding (which may include public sector sources) closer to the roll out of services.

6.42 Option 3 could in principle limit substitution possibilities between large and medium lots. For example, a bidder interested in a particular location that is being offered as a lot in both the combined and phased auctions[30] will need to decide whether to participate in the former auction or to wait until the latter. Either strategy carries risks that this bidder will either not obtain the desired lot or that the bidder will obtain a lot but will have paid more than might have done in the other auction. However, we consider that only a minority of bidders are likely to fall into this category and that any inefficiency would be alleviated at least in part by secondary trading. Overall we consider that the advantages of option 3 significantly outweigh any disadvantages.

Proposals for timing and awards

6.43 We therefore propose to sequence and time a series of awards according to option 3, subject to the availability of suitable frequencies in all the affected areas and relevant expressions of interest.

6.44 The precise timing for the awards under option 3 will need to be refined. However, subject to feedback on issues raised in this and the parallel DDR consultations, and any relevant EU developments (see paragraphs 3.32-3.41), we would presently envisage a series of awards:

- In the initial phase we would award medium lots in the areas where DSO is before spring 2010 and where there are existing RTSLs (these three sites are Caldbeck, Winter Hill and Wenvoe, sites 1-3 in Table 6.1). This stage would occur in late 2008 or early 2009.

- The combined award would take place in 2009 and would award the large lots most suitable for aggregation in all areas in a simultaneous process (likely to include sites from the range in 1-25 in Table 6.1).

- The final phase would then involve the remaining awards of medium and small lots in those areas not already included in the initial phase, where these are

[30] Lots in this case being for the same transmitter but differentiated by frequency.

supported by an appropriate expression of interest (this could include any of the sites listed in Table 6.1). We will not restrict who may apply for each lot to those who have submitted expressions of interest. We consider that it is more practicable to award final phase lots in batches. Hence channels in those localities where DSO occurs in 2011 would be the subject of an award in early 2010, with award in early 2011 in respect of DSO in 2012. This approach would avoid having to hold a large number of separate awards.

Question 8. Do you agree with the proposal for a series of awards of spectrum lots - an award of lots for Caldbeck, Winter Hill and Wenvoe in late 2008 or early 2009, a single award in 2009 of large lots and awards of lots for other locations linked to DSO?

Linkages with the timing of the award of cleared award

6.45 We propose to make the combined award of large lots if possible in 2009. This raises the question of the timing and conduct of this award relative to the cleared award , which is expected to begin in summer 2009. The cleared and the geographic interleaved spectrum may be suitable for similar broadcasting services and bidders may be interested in acquiring both types of spectrum or see one as a partial substitute (or complement) for the other. For example, it is possible that a broadcaster interested in obtaining sub-UK coverage might purchase cleared spectrum. Depending on the channel purchased there could be gaps in coverage because, for example, some locations would have TV aerials 'out of group'. In that case such a broadcaster might wish to purchase geographic interleaved lots in order to fill these gaps.

6.46 Despite these linkages we do not consider that both cleared and geographic interleaved spectrum should be included in the same simultaneous award. To include the 'large' geographic interleaved lots within the cleared award would introduce an additional factor to the specification of lots and would generate a very complex auction which might not lead to efficient participation from all the types of bidders with an interest in the spectrum concerned, and so risks an inefficient outcome. Neither do we consider that we should hold the two awards concurrently, as this would complicate bidding strategies and stretch bidders' resources. Hence our preferred timing is to hold the two auctions sequentially, but in close proximity. The question then is which award should come first.

6.47 As discussed in paragraphs 7.14 to 7.15, when holding a series of awards for similar spectrum, we would generally prefer to award first the spectrum that is likely to be in higher demand. This avoids the situation where a bidder first obtains its second preference in the first award simply to guard against the possibility of being unable to obtain its preferred spectrum in the later award – which would increase the risk of an inefficient spectrum allocation. We consider that in terms of the cleared and 'large' interleaved lots, demand for the latter is more likely to be a function of the outcome of the award of the former. Hence we propose to hold the relevant award for geographic interleaved lots shortly after the cleared award. We would reconsider this sequencing if the timing of the awards changed.

Question 9. Do you agree with the proposal to hold the combined award for large lots of geographic interleaved spectrum shortly after the cleared award in 2009? What should the time interval be?

Expressions of interest

6.48 As discussed in paragraph 6.12, we propose to award spectrum where there is a reasonable expectation of demand. Where appropriate we will assess demand on the basis of expressions of interest that stakeholders submit. This will apply to additional transmission sites for inclusion in the combined award and to all sites to be included in the final phase award. (It will not apply to the sites we have already identified for the combined award or to the early award of Caldbeck, Winter Hill and Wenvoe.) We propose to take separate approaches to expressions of interest for each of these awards.

Combined award

6.49 For the combined award, the set of lots to be auctioned is reasonably clear. The administrative costs of adding or subtracting lots for this one auction are not likely to be material in relation to the potential enhancement in efficient use of spectrum that comes from offering to market lots where there is reasonable demand. It is possible for example that parties wishing to aggregate lots may see value in adding lots in respect of particular sites not presently included in the combined award. In particular, there may be interest in wider coverage, by single operators, of Scotland and Northern Ireland than would be allowed if the transmission sites in the combined award were limited to those in the indicative list of 25. We will consider extending the set of lots to be auctioned in the combined award where we interested parties make a persuasive case that aggregation possibilities would be enhanced by the inclusion of additional lots. We would need to receive such expressions of interest by March 2009 in order to plan for the combined award.

Phased awards

6.50 For the phased awards, we have identified a list of potential transmission sites (see Table 6.1 and paragraphs 6.8 to 6.12 above). We propose to auction these lots only if we receive relevant expressions of interest. Where there is no interest in a lot being awarded it would not be appropriate or efficient for us to establish and administer an auction. In order to strike a balance between the desirability of auctioning lots that may be of interest to bidders and the costs of the auction process, we expect to consider locations for award where we have received expressions of interest that support the need for such an allocation route, including supporting evidence.

6.51 We expect that evidence would include at least a description of the service to be provided, together with evidence of the financial support necessary to take part in the award. These requirements would apply equally to new expressions of interest and to those submissions we have already received that have so far been of a more tentative nature.

6.52 Our present intention is that we would then evaluate any expressions of interest received on the basis of the case put forward. During such a process we may seek more information from the relevant parties in order to understand better the basis of their expressions of interest. The process of completing expressions of interest could also be of benefit to the stakeholders concerned.

6.53 For the final phase we may hold awards in early 2010 and early 2011. The former will be for those localities where DSO occurs in 2011; the latter for localities where DSO occurs in 2012. The outcome of the expressions of interest process will assist us in determining whether we should hold these awards. We propose that the deadline for expressions of interest should be:

- September 2009 for the award in 2010; and
- September 2010 for the award in 2011.

6.54 We would, under this process, evaluate any expressions of interest and make clear in good time for the relevant auction our intention to offer, or not, relevant lots and confirm the associated technical conditions (whether those suited for DTT or alternative spectrum usage rights) for the relevant licences at this time.

Table 6.2 Outline timetable for awards and expressions of interest

Award	Timing of award	Deadline for expressions of interest
Initial phase	Late 2008 or early 2009	Not applicable
Combined award	2009, soon after the award of DDR cleared spectrum	March 2009
Final phase	(i) Early 2010 (ii) Early 2011	September 2009 September 2010

Question 10. Do you agree with our approach to expressions of interest in order to finalise the spectrum lots appropriate to allocate by auction?

Conclusion

6.55 The main points in our proposals for spectrum packaging and the timing of release of the spectrum are:

- We should optimise the possibilities for use of the geographic interleaved spectrum. Table 6.1 sets out a list of 81 transmission sites, with related channels, that we consider to be candidates for award.
- The spectrum lots should be awarded in a phased manner:
  - The initial phase would be the award in late 2008 or early 2009 of 'medium' spectrum lots for Caldbeck, Winter Hill and Wenvoe
  - The combined award would be a single award of 'large' lots in the locations identified as being most suitable for aggregation. This award would be designed to address specifically the requirements of those operators wishing to develop services in a number of locations. It is likely to include all of the 25 indicative locations we identified in the DDR 2007 statement, possibly with additional locations where there is evidence of demand. We intend to offer one 8 MHz channel per location, and the channel will be chosen in order to maximize possibilities for geographic aggregation. We mighty extend the list of lots to be auctioned in the combined award on the basis of any new evidence of demand put to us. We presently anticipate that this would need to be given to us by March 2009.

- The final phase would be the award of ‘medium’ and ’small’ lots ahead of the latter stages of the DSO timetable. This would likely comprise a single batch of lots in early 2010 and another batch in early 2011. The lots to be auctioned would be chosen on the basis of expressions of interest. Evidence supporting expressions of interest would need to be received by September 2009 for lots in 2010 award, and by September 2010 for lots in the 2011 award.

Section 7

Auction design and rules

Introduction and summary

7.1 In this section we develop proposals for the auction designs that we could use to allocate the spectrum lots (discussed and defined in Section 6) in a way that meets our objectives for the digital dividend.

7.2 Spectrum auction design is a specialist and evolving area. We have taken into account experiences both from our own awards programme and relevant international awards, and the specific characteristics of the geographic interleaved awards. This includes the nature of the likely bidders. We have developed our proposals with advice from our auction advisers, DotEcon.

7.3 In this section we:

- describe the auction design options suitable for the initial award of medium lots in Caldbeck, Winter Hill and Wenvoe;
- consider the auction design options for other phased awards of medium/small lots ahead of the latter stages of DSO;
- consider the auction design options for the combined award of large lots in the locations identified as most suitable for aggregation; and
- propose rules and procedures for the initial award, including application and qualification procedures, sample bidding rounds, reserve prices and deposit payments. We also illustrate how an ascending bid auction for the first award would work.

7.4 We discuss in Annex 7 factors that can affect the efficient outcome of an auction and describe in more detail the auction designs that we have considered for the proposed awards.

Auction formats for the initial award of licences for Caldbeck, Winter Hill and Wenvoe

7.5 In deciding what auction design we should use for this initial award our main consideration has been the likely demand for these three lots. We propose to make three 8 MHz lots available, covering each of the Cardiff, Manchester and Carlisle areas. It is likely that the participants in this award would be interested in just one of the lots. None of the lots is a close substitute or complement for another and there are no significant synergies between any of the lots. In this case an auction with bidding for single lots rather than packages of lots is most appropriate.

7.6 There are two candidate single unit auction formats: a sealed bid auction or an ascending bid auction.

7.7 A sealed bid format is a very simple format. Bidders are invited to submit a sealed bid for an individual lot during a single round of bidding. A number of lots may be sold at the same time but the sale of each is effectively a separate auction. Bidders decide how much to bid for a lot, and their bid is valid so long as it is equal to or

greater than the reserve price. The winning bid for a lot is the highest bid for that lot, with any ties resolved using a specified random process.

7.8 An ascending bid auction is a multi-round alternative to the sealed bid auction of a single spectrum lot. In the first round, bidders are invited to submit bids at a reserve price. If there is more than one bid the auction continues and in subsequent rounds prices are increased. In every round, the bidders can therefore evaluate the increasing price for the spectrum lot and determine whether to stay in the auction or drop out. Bidding continues over a number of rounds until there is only one bidder left. In the event that all remaining bidders stop bidding at the same time, a specified random process is used to resolve the tie.

7.9 The advantage of an ascending bid auction over the sealed bid auction is the scope it gives for price discovery. Where bidders have similar but uncertain business cases it may be useful for them to have information on their competitors' bids. This could allow them to refine their own valuations of the spectrum. It is difficult to judge how significant common value uncertainty and price discovery might be for different potential bidders in these awards. The test is whether a bidder is likely to revise its own business case and hence bid strategy if it has information about others' valuations.

7.10 The benefits of price discovery are probably modest in this case, given that there is just one licence available for each geographic area, lots have significant differences, and there could be a diversity of business cases. Nevertheless, it is likely that there could be bidders with similar business cases who share some degree of common value uncertainty. Further, this would be the first spectrum auction in the UK for this type of licence which may contribute to uncertainty about the value of the spectrum. For these reasons we favour using the ascending bid auction format.

7.11 We would not need to hold an auction for a lot if only one applicant was qualified (see paragraph 7.40) to bid. In this case we would award a licence to the one applicant who would pay the reserve price.

7.12 We propose, subject to the outcome of this consultation, to run three single unit ascending bid auctions for these lots.

Question 11. Do you agree that we should run single unit ascending bid auctions for the award of each of the spectrum lots for Caldbeck, Winter Hill and Wenvoe?

7.13 We also need to consider whether to run the three auctions sequentially or in parallel and would welcome stakeholders' views on this question.

7.14 Both approaches should produce a similarly efficient auction outcome and spectrum allocation. The choice between running sequential or parallel awards therefore depends on other factors. One of these is the expeditious completion of the awards. Our main consideration in the timing of these initial awards has been to provide existing RTSLs in Carlisle, Cardiff and Manchester with the opportunity to obtain clarity on their future spectrum holding in advance of early DSO. We should be able to complete parallel awards more quickly than a sequence of awards and, in that case, the RTSLs would know earlier whether they had won a licence. Another factor might be the practicality of bidders taking part in different awards running at the same time. It may be unlikely that a bidder would participate in more than one of the awards, as there are no obvious synergies between the spectrum lots. But even if this were not the case, given the small number of lots, bidders should not find it difficult to participate in three parallel auctions.

7.15 If the auctions were run sequentially, we see no great issue with the order in which we run them, although it might be preferable to run them in the order in which DSO takes place, i.e. awarding Caldbeck first and Wenvoe last. If the auctions took place in parallel, they would all start at the same time and rounds would be scheduled at the same time. However, there would be no linkages between bids in the three auctions, and we propose that we reserve the right to apply different bid increments for each lot. Bidding in the three auctions would probably close at different times. Regardless of whether the auctions are run sequentially or in parallel, our proposals for the application and qualification procedures (which are described below in paragraphs 7.35 to 7.40) would be identical for each auction and we could handle this part of the process as a single operation.

Question 12. Do you have comments on whether the initial auctions of spectrum lots for Caldbeck, Winter Hill and Wenvoe should be run in sequence or in parallel?

Question 13. If the initial auctions are run in sequence do you have a preference for the order in which they run?

Auction design options for the combined award of 'large' lots suitable for aggregation

7.16 In this award, we propose that all licences would be sold at the same time in a single auction. We expect that there is likely to be demand both from:

- Bidders seeking to create a footprint over a wide contiguous geographic area or in a number of metropolitan areas or even nationally, who may have substantial synergy value from aggregating specific combinations of licences.
- Bidders that have purchased spectrum in the cleared award with gaps in geographic coverage that they would like to fill by obtaining suitable geographic interleaved spectrum.
- Local bidders, seeking one or more individual lots, who have no substantial synergies between licences

7.17 In this context, it is not appropriate to use a single unit auction format. Such approaches would create great uncertainty for aggregators in deciding how much to bid for individual licences and unduly expose them to the risk of winning an unwanted or low value subset of their full demand. This could mean that aggregators are unable to express their true value of the available spectrum, with the result that the auction outcome may be inefficient.

7.18 We also consider that a multi-round process would be more likely to promote an efficient outcome than a single round sealed bid process. Given the potentially large number of licences available, it is likely that some bidders could benefit significantly from price discovery over multiple rounds. Further, there are likely to be groups of bidders with similar business cases, who may have some degree of common value uncertainty, who could benefit from observing how other parties behave during the auction.

Characteristics of a simultaneous multi-round auction (SMRA)

7.19 Like the single unit ascending bid auction, an SMRA takes place over a number of rounds. However, it entails a number of lots being bid for in each round. Bidders place bids on one or more of the available lots. Prices increase from round to round

and in response bidders are able to switch demand between lots, subject to any rules on switching that are established for the auction. The auction closes for all lots at the same time when no new bids are made for any of the lots. Each lot is then assigned to the highest bidder for the lot.

7.20 An SMRA should produce reasonably efficient outcomes where there are a number of substitutable lots and common value uncertainty. Bidders benefit from being able to observe the behaviour of their competitors and switch their demand between lots in response to changes in the relative prices of lots. This mitigates substitution risks and may reduce – but not eliminate - aggregation risks.

Characteristics of a combinatorial clock auction (CCA)

7.21 In a simple clock auction bidding for a number of similar lots takes place in a series of rounds. The auctioneer announces the price per lot at the beginning of each round and bidders say how many lots they would like to buy at that price. Bidding continues until the aggregate number of lots bidders are willing to buy at the announced price bidder is no more than the number available. Each bidder remaining in the auction at the end wins the number of lots it bid for in the final round.

7.22 The CCA is a development of this format. It allows package bidding over a number of rounds. This both eliminates aggregation risks and alleviates common value uncertainty. The CCA consists of two phases of bidding: the primary bid rounds; and a supplementary bids round:

- *Primary bid rounds* – The primary bid rounds follow a clock auction format. Bidders make a single bid in each round for a package of one or more lots. Where there is excess demand for at least one of the lots in the auction, prices for the affected lots are increased in the next primary bid round, and the rounds continue until there is no excess demand for any lots.

- *Supplementary bids round* – The supplementary bids round is in the form of a single round sealed bid auction with package bidding. Bidders have the opportunity to make multiple bids for alternative packages of lots, subject to constraints created by their primary round bids.

7.23 Following the conclusion of the supplementary bids round, the auctioneer identifies the highest value combination of bids that can be accommodated, drawing on all valid bids from the primary and supplementary bids rounds and taking at most one bid from each bidder.

7.24 We propose to use this format in the award of the DDR cleared spectrum, for the reasons set out in our parallel consultation on the cleared award auction.

Which auction design is preferable for this award?

7.25 There are potential arguments in favour of both an SMRA and CCA for this award:

- The clear advantage of the CCA is that it eliminates aggregation risks for those bidders wishing to create a footprint over a wide are or in a number of localities or even nationally. They will want to combine lots into packages. By contrast, under any variant of the standard SMRA, aggregators will face uncertainty about how much to bid for individual lots and will be exposed to some extent to winning stranded licences. Changes to activity rules, for example introducing staged

activity requirements or permitting withdrawals under certain conditions, can reduce but cannot eliminate aggregation risks.

- Against this, introducing package bidding through a CCA may create threshold risks for smaller bidders:

  - Threshold risk can affect bidders seeking individual lots or small packages of lots. In this case they may be local bidders, seeking one or perhaps more individual lots, who do not see substantial synergies between lots. These bidders may find it difficult to compete against a bidder that is seeking a larger package made up of the lots that they want. The smaller bidders would defeat the larger bidder if the sum of their valuations was higher than his and all bid to their true valuations. The problem is that some of the smaller bidders may keep their bids below their valuation in the hope that others may make sufficiently high bids for the large bidder to be defeated, but thereby reducing the amount they pay if successful. If enough smaller bidders attempt to free ride in this way it may be that the large bidder will win. This would be undesirable if the more efficient outcome was for the smaller bidders to win.

    In this case, the likelihood of threshold risks distorting bidder behaviour is probably modest provided that we use a second price rule (i.e. where the winner pays the amount of the highest losing bid), because the gains from such behaviour can only be achieved if bidders at the same time expose themselves to the risk of not winning. In an open CCA, local bidders might try to limit themselves in open rounds so as to force others to pay more. However, this type of strategy would only be effective if other bidders are able to monitor bidding behaviour and change their strategy accordingly, as anticipated by the local bidders. Restricting transparency in relation to the identities of bidders during the auction would make such strategies difficult to follow and risky.

  - A related issue relates to bidders who want to obtain a number of lots to cover a wide area or a number of cities. The concern is that such bidders may not bid for some possible smaller packages even though a rational bidding strategy would suggest that they should make such bids. For example, a large bidder might simply judge that it is likely to win a larger package and fail to consider the benefits of also making bids for smaller packages to insure itself against unexpectedly strong bids from other bidders. As a result, smaller bidders may struggle to win specific individual lots even if they value those lots more highly than the incremental value placed on them by the aggregator, because this incremental value has effectively been overstated by the aggregator

- The licences sold will be tradable and so inefficiencies in auction outcomes could in principle be resolved in the secondary market. An aggregator may be able to purchase lots from a number of successful small bidders (who are known). Despite the risk of some of the small bidders holding out, this is generally easier than it is for potential individual smaller purchasers (who may be unknown to each other) to coordinate a purchase of lots from a winning aggregator. Therefore, the risk of enduring inefficiency in spectrum allocation may be greater where the auction format biases the outcome inefficiently towards aggregators.

7.26 The composition of lots proposed for the auction may to some extent affect the competitive dynamics between bidders wishing to aggregate lots and those wanting single lots only. In particular, threshold risks may be slightly less of a concern. There are two reasons for this. One, some single lot bidders may have alternatives that they can pursue in the later auction of lots covering the same or similar geographic areas.

Two, aggregators will be relatively limited in the lots that they can include in their package bids. This improves the relative case for using a CCA format.

7.27 In summary, we consider that a CCA format, with a second price rule, could be used to award the licences proposed for this award. A standard SMRA auction, with suitable activity rules, is a possible alternative. However, we believe a CCA would more effectively address aggregation risks, and that is our preference.

7.28 Following this consultation, we will need to develop a full description of the auction format and rules to be used in the award of 'large' lots, i.e. the 'combined' award. The auction will, as set out in section 6, probably follow the award of cleared spectrum. Since the cleared spectrum is likely to be awarded using a CCA format, a description of the basic format and of the likely associated rules is included within our parallel consultation document on the award of cleared spectrum[31]. This description provides a good indication for the type of format and rules that would apply to the 'combined' auction for the geographic interleaved spectrum if we adopt a CCA format. Annex 8 describes briefly the main features of a CCA. For comparison, we also describe in Annex 9 the main features of an SMRA. We intend to consult later in 2008 on our detailed proposals for the format and key auction rules for this auction, having considered responses to this consultation.

Question 14. Do you consider that a combinatorial clock auction would be more suitable than a simultaneous multiple round auction for the combined award of large lots suitable for aggregation?

Proposed auction design for the phased award of 'medium'/'small' spectrum lots at locations, linked to DSO timetable

7.29 This award has similarities to the initial auctions of the first three lots discussed above. Although there may be a larger number of lots available, interest is still likely to include bidders interested in local service provision. Aggregating bidders are likely to have focused their attention on the previous 'combined' award, although it is possible that they might then see the phased awards as an opportunity to augment any geographic footprint that they may previously have acquired.

7.30 We propose using a single unit ascending bid auction format for these awards, for the following reasons:

- As this award would need to cater for the expected interest from local bidders, substitution and aggregation risks should not be a significant concern. Therefore, it is not necessary to use package bidding or allow switches between lots. Indeed, if package or switched bidding was used, there might be concern about inefficiency as a result of strategic bidding behaviour.

- However, some bidders may have similar business cases but be uncertain about their valuations and they would benefit from price discovery. These benefits are probably modest, not least as bidders would already have gained some information about the market price of spectrum of different characteristics in different locations from the preceding awards, but could still be real, given the regional progress of DSO and the region-specific nature of some of the business opportunities. Hence the potential scope for efficiency benefits is probably

[31] *Digital Dividend Review: 550-630 MHz and 790-854 MHz Consultation on detailed award design*, Ofcom, 6 June 2008, http://www.ofcom.org.uk/consult/condocs/clearedaward/condoc.pdf

sufficient to outweigh any benefits in terms of administrative simplicity from running the simpler single unit sealed bid format.

7.31 We propose to award these lots in two batches. Within each batch we would run a separate auction for each lot and run the auctions either sequentially or in parallel within a short space of time. This approach would avoid having to administer a large number of separate awards at different times. For example licences for locations with DSO before 2011 would be awarded in early 2010, and those for locations with DSO in 2012 would be awarded in 2011. These awards are therefore some way off.

7.32 Our proposal to use the single unit ascending bid auction format is provisional on the outcome of this consultation. We shall consult again later in 2008 on our proposal for the format and key auction rules, although to the extent that we do adopt this approach, the format and key rules are likely to be based in the first instance on those suggested below for Caldbeck, Winter Hill and Wenvoe.

Question 15. Do you agree with the proposal that the phased award of medium/small spectrum lots at locations linked to the DSO timetable should be by single unit ascending bid auctions? If not, which would be your preferred auction format and timing?

Process and rules for the initial single unit ascending bid auctions for the Caldbeck, Winter Hill and Wenvoe licences

7.33 In this sub-section, we set out in summary the process and main rules that we are minded to adopt for each of the three single unit ascending bid auctions. We invite stakeholders to comment on them. Draft award regulations will set out the detailed rules. They will be subject to consultation before we finalise them.

7.34 Each auction would consist of four stages:

- Application stage
- Qualification stage
- Ascending bid stage
- Grant stage

Application stage

7.35 We propose that prospective bidders submit their applications to participate in the award process. Applicants will also be required to pay an initial deposit by the end of the application day. An application constitutes a commitment to acquire a licence at a price no less than the reserve price.

Qualification stage

7.36 We will determine which applicants are qualified to bid based on the rules set out for qualification. We will then announce the number and identity of the qualified applicants. Those qualified applicants then have an opportunity to withdraw from the process by a date that will be defined by us. The remaining participants after the last day for withdrawal are bidders and we will announce the number and identity of the bidders.

7.37 In deciding whether an applicant is qualified to bid we propose to take into account a number of factors. These include whether:

- the grant of a licence to the applicant would be prejudicial to the interests of national security;
- the applicant is a fit and proper person to hold a licence;
- the applicant has submitted false or misleading information to Ofcom;
- any member of the applicant's bidder group has colluded with another person to distort the outcome of the auction process;
- any member of the applicant's bidder group has disclosed confidential information to another person, except where the disclosure is
  - to Ofcom;
  - to another member of the applicant's bidder group;
  - to a provider of finance for the purpose of raising finance for the application; or
  - to a person for the purpose of enabling him to decide whether to participate as a member of the applicant's bidder group;
- any member, or director or employee of a member of the applicant's bidder group who is also a director or employee of a member of another applicant's bidder group is taking part in the preparation of both bidder groups for participation in the award process or receiving confidential information relating to both bidder groups.

7.38 We will also check whether there are overlaps in membership between applicants' bidder groups. We propose to include equivalent rules to those provided for in our previous auctions, most recently the L Band auction[32]. A bidder group will therefore cover the applicant, each associate of the applicant and other insiders. An associate is as any person who has a material interest in the applicant. This will include any person who (whether directly or indirectly):

- holds shares carrying more than 25 per cent of the votes entitled to be cast at a general meeting of the applicant;
- holds shares in the applicant and whose consent is required for the conduct of any business of the applicant; or
- has the right to appoint or remove a majority of the board of directors of the applicant. Where we determine that there is common membership between bidder groups we will notify the applicants concerned and specify a deadline by which all the common memberships must be resolved (i.e. by which a common associate must have disposed of or otherwise removed its material interest in one or both of the applicants concerned, or by which one of the applicants concerned must withdraw from the award process).

7.39 Where a bidder is being supported by a public body they will need to check that any funding is compliant with EC State Aid legislation.

[32] *Award of available spectrum: 1452 – 1492 MHz The document consults on the proposed grant of wireless telegraphy licences to use this spectrum and on the associated auction process,* Ofcom, 31 March 2006, http://www.ofcom.org.uk/consult/condocs/1452-1492/

Where there is only one qualified bidder

7.40 If there is only one applicant qualified to bid we will not hold an auction. We will award the licence to the bidder at the reserve price; the balance of the reserve price will have to be paid before we award the licence.

Ascending bid stage

7.41 If there is more than one bidder we shall award the licence following an auction. The auction will be run using electronic bidding over the internet. Bidding will take place within discrete rounds. In normal circumstances, bidders will be obliged to submit their bids between the specified start and end times for each round. However, there will be provision for extensions to rounds and submission of bids by other means in the event that bidders are unable to submit their bids in the normal timeframe owing to exceptional circumstances (e.g. technical failure outside the reasonable control of the bidder).

7.42 In the first round of the auction the price of each lot will be set at an amount equal to the reserve price plus an increment. In subsequent rounds (if required), the price will be set at an amount equal to the price in the previous round plus a bid increment rounded up to the nearest £1,000. We will have discretion in setting the bid increment between rounds, but it will be a fixed amount up to 100 per cent of the bid amount in the previous round (or reserve price if this was the first round). Bid increments may vary between rounds.

7.43 Having the flexibility to alter bid increments up or down in different rounds should allow us to effectively steer the pace of the auction and react to the level of bidding activity. Larger bid increments will tend to produce fewer rounds and hence shorter auctions, but risk discriminating against those bidders who are unwilling to make large increases in their bids. We will aim to balance these considerations in setting bid increments, perhaps having relatively high bid increments in the earlier rounds compared to the later rounds.

7.44 In each round of the auction, bidders state whether they accept or reject the new bid amount. In the event that a bidder rejects the bid amount for the current round, it will be given the opportunity to specify a maximum bid for the licence at a discretionary amount in whole pounds sterling, which must be greater than the bid amount in the last round (or reserve price if this is the first round) and less than the bid amount that it rejected**.** We call this a discretionary bid.

7.45 If there is a round in which only one bidder accepts the bid amount, that bidder will be the winning bidder. It will pay an amount equal to the next highest bid submitted by another bidder. This approach ensures that a winning bidder always pays the minimum amount necessary (see Annex 7, paragraph A7.7 for discussion of the second price rule). The amount will constitute the licence fee.

7.46 It is possible that all remaining bidders could stop bidding for a licence in the same round. In this case, the bidder that submitted the highest discretionary bid for that licence will be the winning bidder, and it will pay the amount of the next highest bid. If all bidders stop bidding in the same round and two or more of them submit the same highest bid, then a random process will be used to determine the winning bidder from amongst these tied bids. In this case, the winning bidder will pay the amount of its bid.

7.47 The auction will continue until a winning bidder emerges. It follows that bidders' activity will determine the number of rounds in the auction. This is unpredictable, and the auction could be completed in the course of one day or could continue over a number of days.

7.48 The timing of rounds and the interval between rounds, along with flexible bid increments, will allow us to manage the pace of the auction. As with bid increments, we propose to have discretion on timing. Round lengths need only be as long as is necessary to allow bidders to input, check and submit their bids. We consider that 15 minutes should be sufficient. The interval between rounds will need to be long enough for bidders to digest the result of the latest round and to decide how to bid in the next round. We expect to give bidders 30 minutes notice of the start of a round. We would give this notice some time after release of the latest round result. In practice this would mean holding a round about once every hour. As activity in the auction diminishes it may be possible to decrease the interval between rounds and so increase the number of rounds per day.

7.49 Table 7.1 illustrates how the auction might work. The bidders and bids are fictitious and are not intended to provide any information about the potential value or level of competition for licences.

Table 7.1 Illustration of ascending bid auction

Three bidders	The reserve price for Wenvoe, Winter Hill and Caldbeck licences is £25,000 each. Three bidders – Amy, Ben and Colin – submit an application to bid for the Wenvoe licence. Colin also submits an application for Winter Hill. There are no bidders for Caldbeck. Amy and Ben submit a deposit of £25,000. Colin submits a deposit of £50,000.
Is an auction needed for any of the three lots?	An auction is required for the Wenvoe licence, as there are three bidders. No auction is required for Winter Hill; this licence will be awarded to Colin at the reserve price. The Caldbeck licence is unsold.
Auction for Wenvoe	The auction for Wenvoe will be conducted using electronic bidding over the public Internet. Amy, Ben and Colin will be provided with a web address, passwords and digital certificates (that they can install on a PC) in order to have secure access to the bidding system. In advance of each round, the bidders will be notified of a start time and end time for the round during which they must submit their bid.
Commitment to bidding	As part of their applications, Amy, Ben and Colin have all submitted binding bids to buy the Wenvoe licence at the reserve price of £25,000.
Round 1	In round 1 of the auction, the price of the licence is equal to the reserve price of £25,000 plus a bid increment. Suppose that Ofcom sets a bid increment of 40 per cent. The price of the Wenvoe licence is increased to £35,000. All three bidders decide to accept this price.

	At the end of the round, bidders are notified that there were three bids at the current price of £35,000 and that the auction will continue to round 2.
Round 2	In round 2 Ofcom also sets a bid increment of 40 per cent. The price of the Wenvoe licence is increased to £49,000. Now suppose that only Amy and Ben accept this price. Amy's bid form in respect of this round and her acceptance of this price are illustrated in Annex 10. Colin rejects this price and instead decides to submit a discretionary bid. This bid must be less than £49,000 and greater than his previous bid of £35,000. He decides to bid £40,007. At the end of the round, bidders are notified that there were two bids at the current price and that the auction will continue to round 3. (Note that bidders are not told the identity of the bidder who exited the auction).
Round 3	In round 3, Ofcom reduces the bid increment to 20 per cent. £49,000 plus 20 per cent equals £58,800, so this is rounded up to the nearest £1,000. Thus the new bid amount is £59,000. Both Amy and Ben decide to accept this price. At the end of the round, bidders are notified that there were two bids at the current price and that the auction will continue to round 4.
Round 4	In round 4, Ofcom also sets a bid increment of 20 per cent. £59,000 plus 20 per cent equals £70,800, so this is rounded up to nearest £1,000. Thus the new bid amount is £71,000. Amy accepts this price but Ben rejects the price. Ben submits a discretionary bid of £69,002. Ben's bid form in respect of this round, his rejection of the price of £71,000, and his submission of a discretionary bid of £69,002 are illustrated in Annex 10. At the end of the round, bidders are notified that there was only one bid at the current price and that no further bidding rounds are required.
Result of the Wenvoe auction	After the close of the final round, the results of the auction and the highest bids of all bidders will be announced. Amy is the winner of the licence and she pays £69,002. Although Amy's highest bid submitted was £71,000, she only has to pay the amount bid by the second highest bidder, Ben. That is, Amy pays £69,002.

7.50 At Annex 10 is an example of a bidding form that might be used in the ascending bid auction.

Grant stage

7.51 After the conclusion of the ascending bid stage, the award progresses to the grant stage, in which we receive the winning bidder's payment, issue a licence to the winning bidder and publish the auction results.

Other auction rules

Rules prohibiting collusion

7.52 We propose to include rules that expressly prohibit collusion between bidders. These rules will be in addition to general competition law prohibitions on collusion.

7.53 If a member of a bidder group, or any other person to whom its confidential information has been disclosed, discloses confidential information outside the bidder group (other than to Ofcom, to a provider of finance for its bid or to someone who is considering participating in the bidder group), this may lead to an applicant not being qualified to bid, or to a qualified bidder being excluded from the award process and forfeiting its deposit.

Reserve price

7.54 Each lot available for award will carry a reserve price, below which it will not be sold. Our primary objective in the auction is to promote the optimal use of the spectrum. We consider that the main function of the reserve price to meet the objective is to deter frivolous bidders and we should set it at the minimum level necessary to do this without deterring genuine bidders.

7.55 In the awards we have held to date we have generally set the reserve price per lot at £50,000. There has been some variation of this where numerous lots of varying sizes have been available in an award. For example, in the 10 GHz to 40 GHz award reserve prices ranged from £10,000 to £60,000, reflecting both the size of frequency lots and the potential attractiveness of the four frequency bands included in the award.

7.56 In the initial award we are proposing to run three single unit ascending bid auctions. Each lot varies in geographic and population coverage and hence in its potential economic value. Demand for these lots may be from smaller bidders with relatively fewer resources compared with previous auctions with national lots, and so reserve prices to deter vexatious bids could be correspondingly lower. Nevertheless the administrative costs of organising this small set of auctions will not differ substantially from previous national auctions. Overall we believe that these considerations point to reserve prices somewhere in the lower half of reserve prices used in previous awards. Hence we consider it would be reasonable to set a reserve price for each lot at £25,000.

Deposits

7.57 Deposits are upfront payments that will be forfeit if a bidder breaks specific auction rules or a winning bidder defaults on its payment. We require deposits and set their levels to help to deter frivolous applicants and to reduce the incentive for bidders to default. They are returned to applicants who do not qualify to bid and to unsuccessful bidders, less any sums that might have been forfeited for breach of the auction rules. The winner's deposit (less any forfeit) is offset against the licence fee it has to pay.

7.58 There are a number of points in the process when we will require deposits:

- Applicants pay an initial deposit on the day designated for the submission of applications. If an applicant bidder does not do so we will not accept its application. In our previous auctions we have generally set the level of the initial deposit at 50 per cent of the reserve price.

- Before the auction starts we will require bidders to increase their deposits so that they are at least equal to the reserve price.

- During the ascending bid stage we may ask bidders to make additional deposits to cover the amount of their bids. In such cases we will announce a deadline by which bidders must have raised their deposits so that they remain in line with their highest bid up to that point in the auction. This helps to ensure that bidders do not submit bids for which they are subsequently unable to secure the necessary funds to meet their obligations. It is a way of managing the credit risks imposed by individual bidders on the efficiency of the auction process.

7.59 We recognise that any requirement for bidders to make additional deposits to cover the amount of their bids will make it necessary for bidders to establish suitably large lines of credit. This might be relatively more difficult for smaller bidders or those with uncertain funding. We are willing to take into account any expressed difficulties of this kind in formulating auction rules.

Payment terms

7.60 We propose to issue a licence to the winning bidder on full payment of its licence fee; i.e. the price determined through the auction process or reserve price where applicable. Where, after completion of the ascending bid stage, the amount of the winning bidder's deposit (less any sum forfeited) is equal to or more than its licence fee we shall issue the licence and, if necessary, refund any excess deposit. Where the amount of the winning bidder's deposit (less any sum forfeited) is less than its licence fee we will notify the deadline by when it must pay an additional sum to meet the shortfall.

Information policy

7.61 We need to decide how much information to release to bidders on other bidders and their bids. Bidders – and the public more generally – will want the process to be as transparent as possible to help ensure that it has been run fairly and that the reported outcome is correct. Bidders also need information on others' bids to help their decision making in the auction. The downside of releasing information on bids is that it can assist collusion between bidders or give strong bidders the opportunity to indulge in aggressive tactics designed to undermine weaker bidders.

7.62 There are some minimal necessary information requirements. We need to notify applicants of the identity of other applicants in the qualification stage so that they can check for cross membership of bidder groups. In the interests of transparency more generally we would publish the identities of all bidders before the ascending bid stage and, after the auction has ended, details of the winner and bids made by all bidders.

7.63 There is a range of options for releasing information in the ascending bid stage. In order to bid sensibly bidders need some information on activity during each round. It is arguable that they may need to know only how many other bidders have bid in a round. However, we consider that full transparency would make for an efficient

auction, with bidders receiving after each round full information on the bids all other bidders have made.

Forfeit of deposit and exclusion from award process

7.64 We propose that a bidder's deposit may be forfeit in full or in part if it breaches any of the auction activity rules, which cover such things as the submission of false or misleading information and collusive behaviour. A bidder may also be excluded from the auction. Any monetary penalties incurred will be deducted from a bidder's deposit before it is either refunded or set off against payment of a winning bidder's licence fee.

Unsold licence

7.65 If the licence remains unsold at the end of the auction, either through an absence of bids or default, we will choose whatever course of action we consider appropriate at that time in line with our statutory duties.

Question 16. Do you agree with the proposals for the main rules that we are minded to adopt for each of the three single unit ascending bid auctions?

Conclusions

7.66 In this section we have considered which auction formats might be most suitable for these auctions. Table 7.2 below summarises our proposals.

Table 7.2 Proposed format for each auction

Award	Proposed auction format
Initial award of 'medium' spectrum lots for Caldbeck, Winter Hill and Wenvoe	Single unit ascending bid auction for each lot
Combined award of 'large' spectrum lots, which would be suitable for aggregation	Either a combinatorial clock auction (CCA) or a simultaneous multiple round auction (SMRA) – we express a preference for the former
Phased award of 'medium'/'small' spectrum lots at numerous locations, timed to match DSO	Single unit ascending bid auction for each lot

Source: Ofcom

7.67 We have also set out in summary the process and main rules that we propose for the initial auctions of 'medium' spectrum lots for Caldbeck, Winter Hill and Wenvoe. We shall take stakeholders' comments into account in drawing up the rules in detail. Draft award regulations will set out the rules. They will be subject to statutory consultation before we finalise them.

Section 8

Technical licence conditions

Introduction and summary

8.1 In order to manage interference between services it is necessary to define appropriate technical parameters as part of the licence conditions for users of the spectrum.

8.2 In this section we describe:

- our proposals for the technical licence conditions (TLCs) that would be appropriate for new DTT services in the interleaved spectrum;
- at a high level, the approach we propose to adopt to technical licence conditions for services other than new DTT services in the interleaved spectrum; and
- our proposals in relation to keeping new services in the geographic interleaved under the threshold for international coordination.

Spectrum management principles

8.3 One of the key objectives for spectrum management is to control interference between different users. This is achieved by imposing a set of technical licence conditions on the licensee to limit the risk that significant levels of interference are caused to neighbours, both in geography and in frequency terms. These neighbours could be either new services using digital dividend spectrum or the existing DTT services following DSO.

8.4 TLCs can either be focused around the licensees' transmitters or the neighbours' receivers. Traditionally, TLCs were applied to transmitters, effectively restricting their in-band and out-of-band emissions. These conditions, generally termed transmit masks, are relatively simple to understand. It is also relatively easy to assess compliance with this type of TLC, by measuring the in-band and out-of-band power of the licensee's transmitters. Transmit masks allow for a level of flexibility, as the spectrum can be used for a range of services or technologies provided the power profile of a licensee's transmitters does not exceed the limits in the TLCs.

8.5 However, transmit masks do not directly control the interference levels experienced by neighbours, as they do not account for transmitter density. The more transmitters of a given power that there are in a given area, the higher the risks of neighbours experiencing significant interference from them. Hence, with this form of TLC, neighbouring licensees will have less information on the interference levels that they can expect from the transmissions concerned.

8.6 An alternative approach involves TLCs centred on controlling the interference experienced by the neighbouring licensees' receivers. These conditions are known as spectrum usage rights (SURs). As in the mask approach, a licensee with SURs has flexibility in terms of spectrum use, in that it can use the spectrum for a service or usage of its choice provided it does not exceed its SURs. However, unlike mask-based TLCs, SURs require the licensee to manage both the power of the transmitters and their density. For the same transmitter power, a denser network will result in higher interference such that a licensee may exceed its SURs. To ensure it remains

within its SURs, a licensee therefore has to make a careful judgement of its network roll-out based on a trade-off between transmitter power and deployment density.

8.7 Relative to mask-based TLCs, SURs are more complex to define and compliance assessment is not as straightforward. However, because SURs are specified in terms of the interference experienced by neighbouring licensees they directly control the neighbours' interference levels. Hence, neighbours have a better idea of the interference to expect under such a TLC.

New DTT services in the interleaved spectrum

8.8 To date stakeholder interest for new services (other than PMSE and applications for cognitive devices) in the interleaved spectrum has focused on new DTT services. For this type of fixed single transmission site application it is relatively straightforward to determine the appropriate technical licence conditions for each case based on a modification to the UKPM. The UKPM is a TV interference analysis tool developed by Arqiva, NGW and the BBC to plan UK DSO based on interference into and from each transmission site in the UK. Its use in modified form has already been demonstrated in Section 5 to establish the expected coverage and impact of new DTT services in the interleaved spectrum.

8.9 For a given set of additional interference constraints on the existing, post-DSO DTT services, such as those proposed by the median method, the use of the modified UKPM defines for one of more additional channels from a particular transmission site:

- the maximum radiated power that may be used;
- the transmit antenna template (modified as required by any international coordination restraints that apply);
- the polarisation (horizontal or vertical); and
- the height of the transmit antenna on the mast.

These parameters together with the type of modulation scheme used (e.g. 64QAM2/3) enable the service area and population coverage to be defined. However, in order to fully define the technical licence condition a transmission mask is required which specifies the allowable out of band emissions (i.e. emissions into adjacent channels). In this case a simple block edge mask can be applied using the appropriate DVB-T transmitter mask as specified in Ofcom Interface Requirement 2022[33]. Therefore in this case it is straightforward to define the technical parameters required in the technical licence conditions for a service.

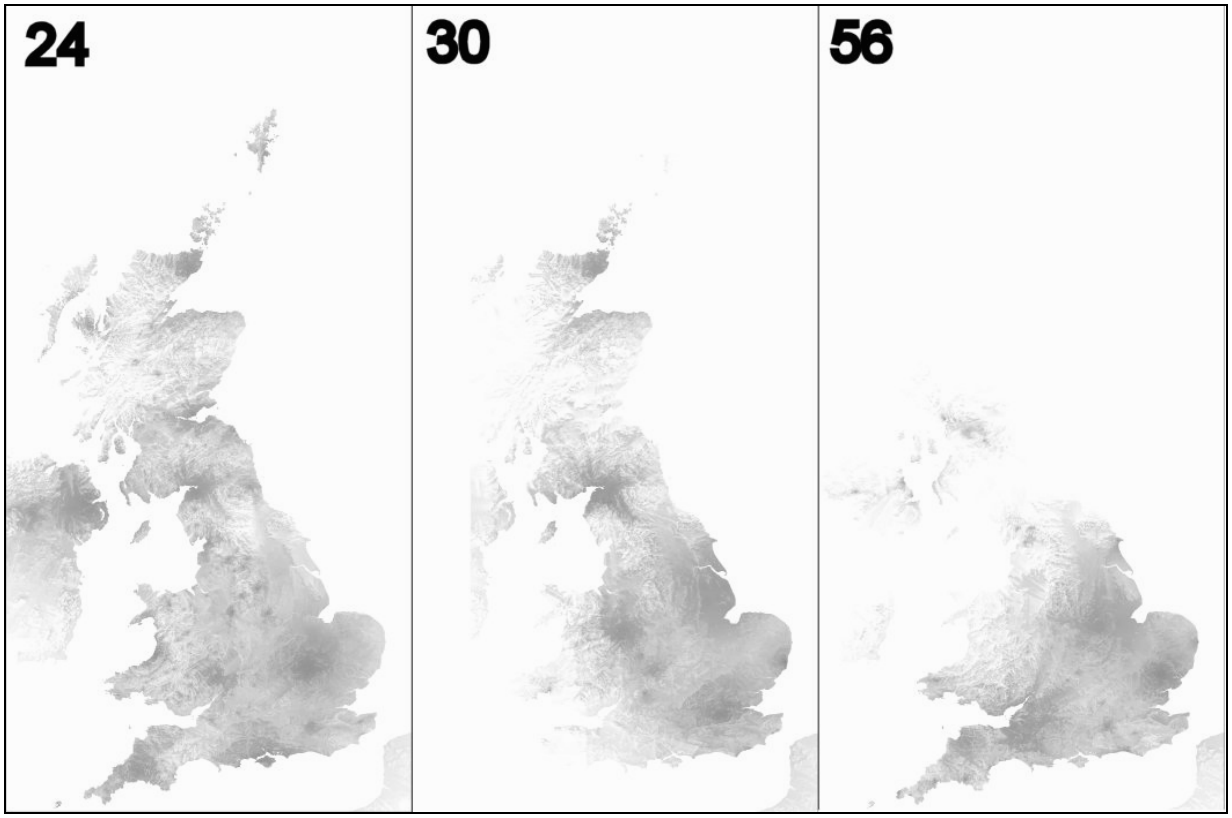
Non-DTT services in the interleaved spectrum

8.10 To date, we have seen limited evidence of interest in using the geographic interleaved spectrum for the provision of new services other than DTT and PMSE (and the potential for applications using cognitive devices) and therefore we have performed relatively little analysis of the suitability of the spectrum for other types of service. However, figure 8.1 provides a top-level illustration of the interleaved

[33] *UK Interface Requirement 2022. Broadcast transmitters operating in frequency bands administered by Ofcom (98/34/EC Notification number: 2007/124/UK),* Ofcom, July 2007, http://www.ofcom.org.uk/radiocomms/ifi/tech/interface_req/ir2022.pdf

channel utilisation in the UK on channels 24, 30 and 36. The darker the colour, the more intense is the use of that channel for existing DTT multiplexes, so white space indicates least intensive use of the channel. Where there is white space it may be possible to establish new services.

Figure 8.1 DTT use of channels 24, 30 and 56 (showing white space)



Source: NGW

8.11 The UKPM is designed to enable modelling of DTT networks. It cannot be directly applied for services other than new DTT services in the interleaved spectrum. It is not clear which specific technology or service will be deployed in the expected term of the licence (see paragraphs 9.34-9.42) and whether it will change in the future, thus highlighting significant uncertainty in the expected interference levels which need to be managed.

8.12 If the spectrum is not used for DTT, there is a greater likelihood of multiple transmitters being deployed to form networks than is customary for DTT services. In this situation we would favour the use of a SUR approach as part of the TLCs. SUR conditions that have been developed for the cleared award can be applied with the additional co-channel constraint of the maximum allowable interference into incumbent DTT services. Interested parties should refer to Section 5 in the cleared consultation document which describes the TLC applicable to that spectrum. We would expect to be consistent and apply the same approach to non-DTT services in the interleaved spectrum.

8.13 We recognise that the use of the interleaved channels by existing DTT services and the guard bands between DTT and other services proposed in the cleared consultation may make it difficult to provide non-DTT services over a significant

geographical area. Based on the level of interest we will consider further the implications of non-DTT services in the interleaved spectrum.

Protection of existing DTT multiplexes

8.14 We have considered whether it would be appropriate to insert a further TLC in the licences to be awarded for the geographic interleaved spectrum to protect the reception of the existing DTT multiplexes. We have proposed that such a protection clause' is included in the licences to be awarded for the cleared spectrum[34]. However the circumstances in the geographic interleaved award are different. The rights to use the spectrum for new DTT services that we are proposing to award will be tightly defined using the UKPM and a fixed set of interference entries into existing DTT services. Also we are not proposing initially to include in the licences the right to use the spectrum for services other than DTT. Accordingly, in this case no additional protection is required for the existing DTT multiplexes and we do not, therefore, propose to include a protection clause in the licences for this award.

8.15 We recognise that, as technology develops, there may be other uses for the spectrum, and reasons to change the technical parameters in the licences. Should a licensee wish to change the technical parameters of its licence, or provide other services than DTT, we would consider inserting a protection clause to protect the existing DTT multiplexes. In particular, if the licences were varied to allow provision of new services other than DTT in the geographic interleaved spectrum then since there may be less certainty as to the interference entry into existing DTT services it may well be appropriate to include an additional protection clause to ensure that existing DTT are protected.

8.16 Further information about the matters we considered in relation to the protection clause is set out in Annex 11.

Post award licence variations

8.17 Our approach to spectrum management seeks to be technology and service neutral. However, as stakeholder interest in new services in the interleaved spectrum has centred almost exclusively on DTT we have focused our technical work on optimising the frequency/channel allocation for this type of service. This in turn means using existing DTT transmission sites (to which existing viewer aerials are pointing) and the use of channels that are in (or close to) the group of the aerials used by viewers in the area. The TLCs are then derived from the UKPM with the addition of a transmission mask. Therefore, licences of this type are quite prescriptive in terms of their application.

8.18 Where there may also be interest in services other than digital TV we assume that, in general, prospective service providers will be interested in spectrum that is likely to minimise the potential for interference to TV. These frequencies will typically be out of the local TV aerial group and probably using transmission sites at locations other than existing DTT transmission sites. This type of service is likely to operate under an appropriate SUR and may be expected to offer greater flexibility in terms of post-award licence variation. All proposals for licence variations will be considered on a case by case basis.

[34] See section 5 of the Cleared consultation, http://www.ofcom.org.uk/consult/condocs/clearedaward/condoc.pdf

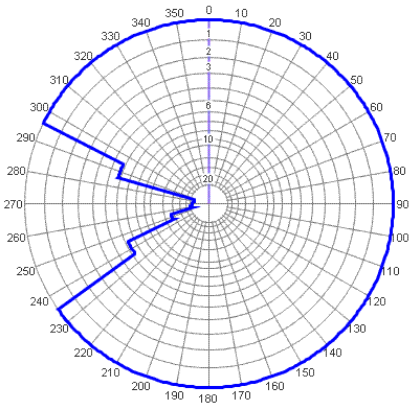
Question 17. Do you have any comments on the technical licence conditions we are proposing to include in the licences?

International coordination

8.19 GE-06 specifies, for new DTT services in the UHF and VHF bands, field strength levels above which international coordination is necessary. As a rough rule of thumb in the UHF band, if the field strength is 23dBuV/m or lower at the neighbouring country's coastline or border, additional coordination is not required with that country. NGW has produced additional antenna templates to limit the field strength to no more than this 23dBuV/m trigger level to avoid international coordination. These will sometimes imply that the number of households that can be covered by a given channel at a given location will be lower than without such a constraint.

8.20 As an example, Figure 8.2 shows the international coordination template for a new DTT service from Winter Hill which must be added on to the UK template. The restriction shown to the west is to limit the field strength to below 23dBuV/m at Ireland's coast.

Figure 8.2 International coordination template for Winter Hill



Source: NGW

8.21 Limiting new DTT services exported field strength transmissions in the interleaved spectrum to below the GE-06 threshold avoids the need for international coordination. Exceeding the threshold would require negotiations with our neighbouring countries, with no guarantee of success. We therefore propose that licences for the geographic interleaved lots will not allow the coordination threshold to be exceeded. However, we may consider requests for opening such negotiations after lots have been auctioned if there are compelling arguments for doing so.

Question 18. Do you agree that the licences for the geographic interleaved spectrum should not allow the co-ordination threshold to be exceeded?

Section 9

Non-technical licence conditions

Introduction and summary

9.1 In this section we discuss non-technical usages rights that we propose to place in the licences that we will auction. In particular, we discuss our proposals on

- DTT multiplex issues – setting out certain ownership restrictions reflecting the regime applied by the Broadcasting Act 1996 and allowing us to facilitate interoperability between existing and any new DTT multiplexes;
- Making the WTA licences tradable in secondary markets;
- Licence commencement and duration;
- The duration of the initial period, our limited rights for revoking the licence during this period and any additional powers we have following the initial period;
- Non-technical restrictions;
- Service obligations; and
- Provision of information to promote efficient use of spectrum.

9.2 Before moving on to the discussion on the non-technical proposals, we believe it is worth recapping on our December 2006 consultation proposals and the stakeholder responses. The December 2006 consultation document proposed a number of specific non-technical usage rights and obligations to be included in the Wireless Telegraphy licences to be awarded. These were:

- We proposed an indefinite licence duration, with a initial term lasting until 2026 (subject to five years' notice of variation or revocation);
- We proposed that all licences would be tradable, with all legal forms of trading to be permitted;
- The licences would not restrict the technology or type of equipment to be used, or the service to be offered (other than the minimum technical restrictions necessary to control harmful interference); and
- We proposed that the licences should not contain rollout obligations or 'use it or lose it' conditions.

9.3 A small majority of responses 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.

9.4 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 existing DTT multiplexes.

9.5 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.

9.6 We have taken the above responses into account when developing our proposals for this award.

DTT multiplex issues

9.7 The 2006 DDR consultation noted that the Communications Act gives us the power to operate a simpler and more flexible regime that would allow spectrum to be used to carry broadcast services such as those already available on the DTT platform (which are licensed under the Broadcasting Acts).

9.8 Under this regime it is only necessary to hold a licence under the Wireless Telegraphy Act in order to operate a multiplex that may carry broadcast services. It is not necessary also to hold a multiplex licence issued under the Broadcasting Act.

9.9 The DDR statement confirmed that we expected to use this new regime in relation to the digital dividend spectrum, removing the requirement for a person to hold a multiplex licence under the Broadcasting Act 1996. Content providers would however still need to hold the appropriate Broadcasting Act content licence.

9.10 The DDR statement also noted that we had considered whether it would be desirable to retain some limited elements of the Broadcasting Act regime, and that we would set out proposals in this consultation document regarding the inclusion of certain ownership restrictions to disqualify certain groups from operating a television or radio multiplex and to address interoperability between the existing DTT platform and any new television multiplexes using the digital dividend.

9.11 The proposals below apply equally to the cleared and band manager awards and the consultation documents relevant to these awards set out the relevant proposals.

9.12 We have also considered whether there are other aspects of the obligations contained in Broadcasting Act multiplex licences that should be retained under the approach that we propose to adopt, of awarding licences under the Wireless Telegraphy Act only. In particular, Broadcasting Act licences typically contain conditions relating to competition.

9.13 However, we consider that the proper context in which to consider potential conditions relating to competition issues is in relation to a discussion of the effects of the award on competition more generally, and the potential effects on relevant markets. This is in section 9.

Ownership

9.14 We think that there are important reasons for considering whether to impose any restrictions on the identity of persons who may hold the WT Act licences that are the subject of this award for the purpose of operating a radio or TV multiplex.

9.15 The fundamental point is that, whatever the technical and operational distinctions between existing DTT multiplexes (operated under both a Broadcasting Act licence and WT Act licence) and new DTT multiplexes (which may be operated under a WT Act licence only), the services that they provide may be indistinguishable in the eyes of viewers.

9.16 As noted above, content providers are required to hold the appropriate content licence issued under the Broadcasting Act. This requirement applies to content providers across all broadcasting platforms. At the platform level, however, Parliament has deliberately chosen to distinguish between the provision of those services via a multiplex —disqualifying certain categories of person from holding a Broadcasting Act multiplex licence—and via other networks (e.g. satellite and cable).

9.17 Categories of persons disqualified from holding multiplex licences under the Broadcasting Act 1990[35] include the following:

- local authorities;
- political bodies;
- religious bodies;
- publicly-funded bodies;[36]
- bodies exerting undue influence;
- broadcasting bodies, specifically the BBC and Welsh Authority; and
- advertising agencies.

9.18 The Communications Act obliges us to consider the ownership rules in relation to broadcast media at least every three years. It does so in the recognition that communications markets are developing rapidly and likely to continue to do so, which may in time mitigate the need for specific ownership restrictions and rules. Our first review in November 2006 concluded that there was no clear reason for such changes.[37]

9.19 We have borne these conclusions in mind in considering which, if any, ownership restrictions to apply to the use of the cleared spectrum to operate a DTT multiplex. At the same time, we have had regard to our duty to ensure our actions are targeted only at cases in which action is needed.

9.20 Where the geographic interleaved spectrum is used to operate a multiplex for carrying DTT services, we propose to:

- include ownership restrictions that replicate those in the Broadcasting Act relating to –
  - local authorities;

[35] www.opsi.gov.uk/acts/acts1990/ukpga_19900042_en_1. Subsequently amended by the Broadcasting Act 1996, the Competition Act 1998, the Enterprise Act 2002 and the Communications Act 2003.
[36] Radio-service licences only.
[37] www.ofcom.org.uk/research/media_owners/rulesreview/rules.pdf.

- political bodies;
- religious bodies; and
- bodies exerting undue influence; but

- not to replicate the restrictions related to –
  - broadcasting bodies. This no longer appears appropriate given that BBC Free to View Ltd already holds a Broadcasting Act multiplex licence (for Multiplex B), and is directly under the control of the BBC;
  - advertising agencies. We do not believe it would be justified to restrict persons in this class from holding a WT Act licence, and all content restrictions in relation to advertising will apply in any event via the regulation of content provision.

Question 19. Do you agree that where the geographic interleaved spectrum is used for the operation of a DTT multiplex, we should replicate the ownership restrictions from the Broadcasting Act regime relating to (a) local authorities, (b) political bodies, (c) religious bodies and (d) bodies exerting undue influence but not replicate restrictions relating to (e) broadcasting bodies and (f) advertising agencies?

9.21 In proposing that we replicate the ownership restriction related to local authorities, we have been mindful of our position, set out in the DDR statement, that explicit support through direct funding for services that can provide broader social value is more transparent and can achieve a better outcome than reserving spectrum for those services. We therefore wanted to ensure that this ownership restriction would not work against any services (e.g. local television) that might require funding from such sources to be viable.

9.22 We believe that it is entirely feasible to separate funding of the acquisition of spectrum from the ownership of a DTT multiplex. The ownership restriction related to local authorities should not prevent potential funding from such bodies for those wishing to provide local television services provided the funding does not give rise to '*de facto*' control of a multiplex or 'undue influence' adverse to the public interest:

- *De facto* control – this will arise if the funding arrangements put the provider of those funds in the same position as a controlling shareholder. This is more than mere influence, allowing the local authority to fulfil its wishes over and above other shareholders.
- Undue influence adverse to the public interest – there must be no influence exerted on the multiplex owner which may serve political or other ends. Limited financial assistance, in the form of a loan or grant, may be acceptable provided it does not result in the exertion of influence which is adverse to the public interest. Each grant or loan would need to be considered on a case by case basis.

9.23 We encourage bidders requiring direct funding to acquire this spectrum to think about how they can secure funds from a variety of sources (including but not limited to local authorities) and to ensure that they comply with all the rules relating to funding.

9.24 In considering how best to implement in Wireless Telegraphy Act licences the ownership restrictions which are equivalent to those currently included in Broadcasting Act multiplex licences, we will also need to consider whether any

related conditions are required in order to enable us to monitor and audit compliance with the ownership restrictions imposed, for example, requiring the licensee to inform us of any change in ownership and to provide us with relevant information at our request regarding ownership, control and undue influence.

Interoperability

9.25 Viewers benefit from and greatly value being presented with a common service across all existing DTT multiplexes. This outcome is achieved by the current framework under which the existing multiplexes interoperate. This is necessary because the multiplexes are independent of each other, unlike vertically integrated platforms like satellite or cable, and so some cooperation between the multiplex owners is required to ensure that viewers on any particular multiplex are presented with a common set of services rather than the service offerings of that particular multiplex.

9.26 When the first DTT multiplex licences were awarded in 1998, the Independent Television Commission required compliance with its Technical Code and associated Community Digital Standards. These documents now exist as the Ofcom Television Technical Code[38] and Reference Parameters for Digital Terrestrial Transmissions in the United Kingdom,[39] which define the technical standards and operating parameters that the existing multiplex operators are required to adopt. The latter document details a subset of transmission standards agreed within the European Telecommunications Standards Institute (ETSI) to which operators should adhere:

- frequency parameters – what kinds of signal are used to carry a multiplex (e.g. DVB-T, 64QAM);
- encoding standards – how the programmes carried in the multiplex are put into a form suitable for broadcasting (e.g. MPEG-2, MPEG-4);
- service information – the data stream normally invisible to viewers that is essential for receivers to operate. Some parts of the stream are used to populate the Freeview electronic programme guide (EPG), allowing viewers to obtain up-to-date information on all DTT services regardless of what they are watching;
- Application Programme Interface – the software that displays graphics and enables interactive services to function (e.g. MHEG-5); and
- access services (e.g. subtitling).

9.27 At the same time, there is focused voluntary cooperation on the part of the multiplex operators in addition to compliance with the two documents mentioned above. This takes place through the Digital Television Group (DTG),[40] which publishes, maintains and promotes adherence to the D-Book, setting out the detailed technical standards for DTT in the UK, and runs the sector's test and conformance centre. The operators also pay for and maintain equipment such as the Central Service Information

[38] See http://www.ofcom.org.uk/tv/ifi/tech/codes_guidance/tv_tech_platform_code.pdf
[39] See http://www.ofcom.org.uk/tv/ifi/tech/codes_guidance/dttt_uk2.pdf
[40] DTG is the industry association for digital television in the UK. It is independent and platform neutral. It was formed in the mid-1990s to facilitate the introduction of DTT in the UK and has a wide membership including Ofcom, multiplex operators, broadcasters, consumer bodies and equipment vendors.

Collator, which combines information on programmes on all the multiplexes to produce the service information broadcast on each.

9.28 Against this backdrop, and given the possibility that cleared spectrum will be used to deliver new DTT services, we have considered the issue of interoperability with the existing multiplexes and the extent to which regulatory intervention may be needed to secure this. We have identified three options:

- **Do nothing**. Under this option, interoperability would only arise through the voluntary agreement of existing and new multiplex operators. It could be achieved by new operators adopting the same technical standards and operating parameters as existing operators and existing operators adapting their systems as necessary to accommodate new operators. Given that under this option interoperability will only arise if the new and existing multiplex operators can reach agreement, there is some risk that it will not be secured in the future. Our initial view is given that in the past consumers and citizens have benefited from the existence of interoperability arrangements it is likely to be unattractive to take this risk. We have therefore identified two further more proactive options.

- **Facilitate**. Under this option, we would require existing multiplex operators to interoperate with new operators at the request of the latter. We would propose to vary existing operators' Broadcasting Act licences if necessary to achieve this. If new operators wished to take advantage of this opportunity, they would need to operate within the same technical code and operating parameters as existing operators. They would not therefore be free to adopt some aspects of the technical code and operating parameters while rejecting others. (However, the technical code and operating parameters themselves include a number of choices open to multiplex operators.) This option preserves some flexibility for the new operators since it is not overly prescriptive about whether and when interoperability is achieved but it would set out a clear expectation that it will occur subject to the choice of new operators. It also would enable us to intervene if circumstances frustrate such agreements being reached. It does not, however, guarantee viewers the benefits of interoperability across all multiplexes and nor that this will happen at the earliest possible time. We stress that we would expect new operators gaining interoperability in this way to play a full role in the maintenance and development of the DTT platform rather than adopt a pick-and-mix approach to its individual components;

- **Mandate**. Under this option, we would require existing and new operators to interoperate in full as specified by Ofcom both in terms technical standards and the time at which it should be achieved. Again, new operators would need to adopt the same technical standards and operating parameters as existing operators, while we would vary existing operators' Broadcasting Act licences as necessary. This would guarantee viewers the benefits of interoperability across all multiplexes but at the expense of automatically precluding alternative market offerings that could deliver different, possibly greater benefits. As yet we are not aware of a compelling reason to intervene to this extent.

9.29 On balance, our initial view is that interoperability is likely in the future to bring benefits to consumers and citizens as it has in the past. Therefore, if the spectrum is to be used for new multiplexes we consider it appropriate to take some steps to encourage the emergence of interoperability so that those benefits are realised in relation to such new multiplexes. However, our preference is for the industry to secure this itself within a framework set by Ofcom rather than for Ofcom to mandate

interoperability. Accordingly, we propose to facilitate interoperability between existing and new multiplex operators at the request of the latter.

Question 20. Do you agree that we should facilitate interoperability between existing DTT multiplex operators and new operators using cleared spectrum?

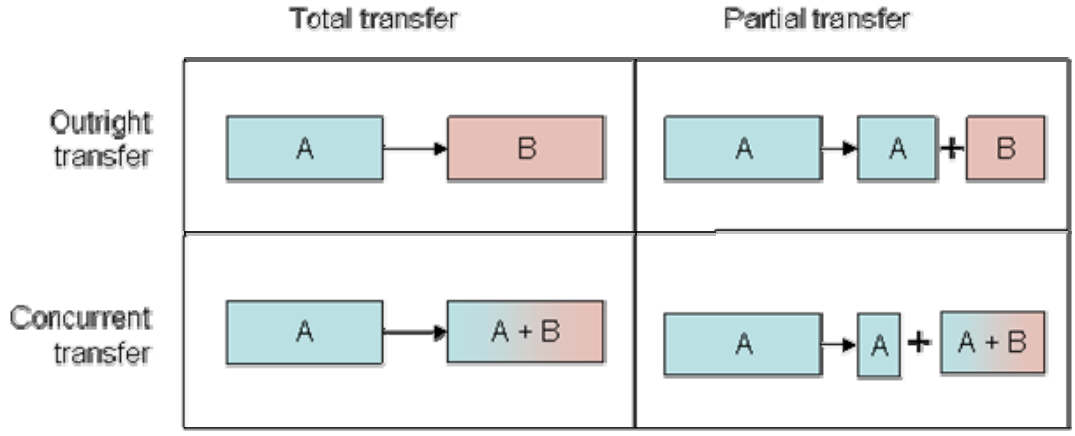
Spectrum trading

9.30 We began the implementation of spectrum trading for selected licence classes in 2004, through the Wireless Telegraphy (Spectrum Trading) Regulations 2004. The changes, described in the Spectrum Trading Statement, published in August 2004, introduced the possibility for licensees in specific classes to carry out:

- outright total transfers, i.e. transfers of all of the rights and obligations arising under a licence to a third party;
- concurrent total transfers, i.e. transfers of all of the rights and obligations arising under a licence to a third party which result in a concurrent holding of those rights and obligations by the transferor and the transferee(s);
- outright partial transfers, i.e. outright transfers of some of the rights and obligations arising under a licence to a third party; and
- concurrent partial transfers, i.e. transfers of some of the rights and obligations arising under a licence to a third party which results in a concurrent holding of those partial rights and obligations by the transferor and the transferee(s).

9.31 Figure 9.1 illustrates these four generic types of transfer.

Figure 9.1 Illustration of some possible types of transfer



Source: Spectrum Trading Guidance Notes - http://www.ofcom.org.uk/radiocomms/ifi/trading/tradingguide/

9.32 In the case of the licences for the geographic interleaved spectrum, we propose to amend the Wireless Telegraphy (Spectrum Trading) Regulations to allow all of the above types of transfer to occur for the licences awarded.

9.33 It should be noted that trading is not currently possible in Jersey (because Section 30 of the Wireless Telegraphy Act does not extend there) or Guernsey (because, while Section 30 of the Wireless Telegraphy Act does extend there, the Wireless

Telegraphy (Spectrum Trading) Regulations 2004 do not). We are talking to the authorities in both islands about their expressed interest in introducing trading, at least for licences for the spectrum subject to this award.

Licence commencement and duration

9.34 It was proposed in the Spectrum Framework Review: Implementation Plan[41] that new licences to be awarded by auction should generally have an indefinite term with a initial term. During the initial period the grounds for revocation would not include a general right to revoke for spectrum management reasons. After the end of the initial term, the grounds for revocation would include such a right, subject to a minimum notice period of five years. We also proposed that notice of revocation for spectrum management reasons could be given so that the licence ended the day after the expiry of the initial term.

9.35 The aim of these proposals was to provide licensees with a initial term during which they would have high security of tenure, and grounds for revocation would be limited to a narrowly defined set of conditions. The period of the initial term should be linked to a reasonable view of the period required efficiently to earn an appropriate return on the investment anticipated for efficient use(s) of the spectrum, and take into account any other factors that are relevant. The aim of proposing an indefinite duration was to give the licensee the opportunity to continue operating its business beyond the initial term. However, during this period we would be able to recover the spectrum by serving a notice of revocation in a similar manner to many other spectrum licences, if this step was justified on spectrum management grounds. In addition we would reserve the right to charge AIP in this period to incentive efficient use of the spectrum.

9.36 We consider that there are a number of reasons why licences with an indefinite term are likely to promote optimal use of the radio spectrum and other relevant objectives, including the promotion of competition.

9.37 In particular, the award of licences with an indefinite duration reduces the need for regulatory intervention to reassign spectrum at the end of the licence term. One disadvantage of fixed term licences is that at the end of the licence term the licence expires and so the rights to use it must be returned to the regulator, unless any other action has been taken. This may result in a period during which the spectrum remains unused as the regulator must go through a process to reassign those rights. Furthermore, incentives to invest closer to the end of a licence term are significantly reduced given that communications networks generally require continual investment. This lack of investment could result in detriment to consumers and citizens. The alternative of licences with an indefinite duration removes the requirement for return to the regulator, removes the risk of discouraging investment and creates additional opportunities for the market to secure the efficient use of the spectrum, particularly in the presence of spectrum trading.

9.38 We consider that, as a matter of principle, it is preferable to look to market mechanisms to promote the efficient use of resources rather than regulatory intervention, unless the case for such intervention is clear. To date we have not identified a general need for us to recover spectrum at the end of the initial term in relation to any of our spectrum awards.

[41] *Spectrum Framework Review: Implementation Plan. This document consults on the release of spectrum in 2005 – 08, and on extending spectrum liberalisation and trading to mobile services*, Ofcom, 13 January 2005, http://www.ofcom.org.uk/consult/condocs/sfrip/sfip/

9.39 We consider that there are likely to be a number of other advantages to adopting the general approach proposed above. In particular, reassignment by the regulator typically takes significant time and resource. The spectrum may also lie idle for a period as the regulator prepares for reassignment. While it may be possible to reduce this problem through the use of overlay auctions, the approach of an indefinite term together with spectrum trading seem likely to offer a simpler and less costly way of ensuring the spectrum is used efficiently.

9.40 We therefore favour offering licences with an indefinite duration for the cleared spectrum. The retention of powers to revoke on spectrum management grounds provides a mechanism allowing regulatory intervention if this is justified in particular cases

9.41 The inclusion of an initial term in the licence is desirable in order to give sufficient certainty to investors to incur the necessary costs to put the spectrum into use. Without an initial term there is a risk that this may not occur and so the spectrum would not be used efficiently.

9.42 Consistent with the above general policy framework, we propose to take the following approach in respect of duration for licences issued for spectrum subject to this award:

- the licences to have an indefinite duration;
- the licences to have a initial term of a specified duration, as discussed below;
- we will be able to revoke the licences before the expiry of the initial term on the limited grounds set out below; and
- we will be able to revoke the licences from any point after the expiry of the initial term on the grounds set out below, but also for spectrum management reasons subject to us giving five years notice; it will be possible for us to give notice of revocation during the initial term, for revocation to take effect after expiry of the initial term.

Rights to revoke licences during the initial term

9.43 The initial term is designed to provide licensees with a high security of tenure for investment planning purposes. During that period, we will not be able to revoke licences for spectrum management reasons and will only be able to do so in the particular circumstances described below.

9.44 During this initial term the licence may only be revoked for the following reasons:

- with the consent of the licensee;
- for non-payment or late payment of the relevant licence fee;
- if there has been a breach of any of the terms of the licence;
- if the licensee has not complied with any requirement of any relevant trading regulations;
- if the licensee has not complied with the auction regulations under which the licence was awarded, including any financial provisions including guarantees;

- we may at any time, by notice in writing, revoke or vary licence terms if it appears to us to be requisite or necessary or expedient to do so in the interests of national security, or for the purposes of complying with a Community obligation of the UK or with any international agreement or arrangements to which the UK is party; and

- if it appears requisite or necessary or expedient to do so for the purpose of complying with a Direction by the Secretary of State under Section 5 or Section 156 of the Communications Act.

Additional powers after the initial term

9.45 When the initial term has expired, the licence will remain in force and continue to be held by the licensee. Two additional conditions would then also apply:

- one relating to additional licence fees that we expect to be payable after the end of the initial term; and

- one providing an additional power to allow us to revoke or vary the licence on spectrum management grounds.

9.46 We consider these in turn below, addressing first the position in relation to fees after the initial term, and then the power to revoke on spectrum management grounds.

9.47 Our expectation is that, after the end of the initial term, licensees who wish to hold the licences issued under this award will need to pay additional licence fees. The level of these fees will depend on our general approach to fees for the use of spectrum at the time, and how that general approach relates to these licences and to our statutory duties at the time. The level of the fees cannot therefore be determined now. However, our expectation is that it will be appropriate to set fees based on Administered Incentive Pricing (AIP). The reasons for this are explained in more detail below. We also expect fees, as a minimum, to be sufficient to make an appropriate contribution to the costs of regulation.

9.48 AIP presently plays an important role in incentivising the efficient use of spectrum, and is widely applied to licences to use spectrum. Indeed, we have recently stated our intention to extend AIP to certain types of spectrum use that do not presently face AIP (such as terrestrial broadcasting and certain aeronautical and maritime uses). We have also stated that, in general, we expect to continue to apply AIP to licences after they have been made tradable, and that AIP may also be applied to licences that have been auctioned by us, after the end of the initial term. This is because the application of AIP is likely to promote efficient use of the spectrum, by sending very clear and tangible signals to users about the opportunity costs of using spectrum.

9.49 In relation to the licences that are the subject of this award, our view is that the application of AIP after the end of the initial term is likely to help secure the efficient use of the spectrum in the long term. This is because the application of AIP should be a complement to other policies designed to secure efficient use of the spectrum, notably the policies of awarding the spectrum by auction, and of making the spectrum licences tradable and liberalised. We consider that the advantages of applying AIP after the initial term are likely to outweigh any disadvantages, provided AIP is set at a level that is unlikely to deter efficient use.

9.50 We have taken account of the importance of the spectrum that is the subject of this award in considering this matter, and its usefulness. It is important to note that we

would expect to give prior notice of our specific proposals to charge fees, and to consult as appropriate, before fees are introduced.

9.51 We also consider that it is appropriate for us to have wider powers to revoke or vary the licences that are the subject of this award after the end of the initial term. This reflects the greater uncertainty that will exist in the more distant future about the conditions that will make for optimum use of spectrum. We consider that market mechanisms should promote efficient use of spectrum, and be much more successful in this respect than widespread reliance on regulatory controls. The tradability and liberalisation of spectrum are key elements of a market-based approach. However, there may be circumstances in which additional intervention is justified in the public interest (for example, to overcome a specific market failure such as problems of co-ordination caused by high transaction costs).

9.52 We consider that it is in the public interest for us to have a greater power to take regulatory action, if justified, in relation to the use of the spectrum in the long term. This can be achieved by having an additional power to revoke or vary the licence on spectrum management grounds after the end of the initial term.

Duration of the initial term

9.53 As mentioned above, the initial term should be linked to a reasonable view of the period required to efficiently earn an appropriate return on the investment anticipated for efficient use(s) of the spectrum. We have considered the relevant period that might provide a reasonable chance for the businesses that might be most likely to operate in the bands to make an appropriate return on efficient investment without unnecessary regulatory risk.

9.54 Analysis already undertaken in connection with previous awards and our December 2007 Statement suggests that the minimum operational term of a licence supporting substantial new investment in a network would need to be in the region of 15 years. This approach was used in our 10-40GHz and L Band Awards. This is also in the middle of the range suggested by broadcasters in response to our December 2006 Consultation. Without a degree of certainty that they will be able to offer services for at least this sort of period of time, licensees are unlikely to be willing to make the investments necessary to efficiently exploit this spectrum.

9.55 At the same time use of the geographic interleaved digital dividend spectrum will not be possible on a UK-wide basis until 2012, with for example use in London not being possible before then. If such licensees are to have a reasonable prospect of earning a commercial return on their investments they will therefore need a reasonable degree of certainty that they will be able to continue offering service through to around 2027.

9.56 We also consider that there are a number of factors which are relevant to determining the initial term. The first of which is three of the existing DTT multiplex licences, if renewed, will reach the end of their renewed term in 2026 (12 years from 2014). We think there is merit in synchronising the end of the initial term for the new licences to be awarded for the digital dividend spectrum with the end of the renewed term for these existing DTT multiplexes which could enable a comprehensive assessment of the efficient use of the UHF spectrum at that time.

9.57 The majority of respondents to the December 2006 DDR consultation agreed with our proposal on linking the initial term with the expiry date of the three existing multiplexes.

9.58 We therefore propose that the initial term for the new licences to be awarded for the digital dividend spectrum should end in 2026.

9.59 We propose that the rights to the geographic interleaved spectrum should be available from completion of DSO in each region. We have no reason to suppose that DSO will be delayed. However if a delay does occur this will lead to a corresponding delay in the date from which the new rights to use of this spectrum can take effect.

Non-technical restrictions on use

9.60 In the light of our intention that the digital dividend be available on a service- and technology-neutral basis, we do not propose to impose any non-technical restrictions on the use to which the spectrum could be put in the licences (such as specifying the service that could be offered, the technology that could be deployed or the equipment that could be used).

Service obligations

9.61 Section 10 and Annex 12 discusses the appropriateness of 'use it or lose it' conditions and roll out obligations. For reasons explained there we do not propose to impose either of those obligations in this award. This is consistent with our general policy statements[42], which explain that such conditions are unlikely to be justified as a means to promote optimal use of the spectrum, which would instead be better achieved through other market-based mechanisms such as a competitive award process, spectrum trading, liberalisation and spectrum pricing.

Provision of information to facilitate optimal spectrum use.

9.62 In line with our duty to manage the spectrum efficiently, we propose to include a standard condition in the licences for the geographic interleaved spectrum to require licensees to provide us on request with general information regarding their equipment and use of frequencies, or the roll-out of their network. From time to time, we may publish aggregated information received on the number of base stations and frequency use in area across the UK, in order to help secure optimal use of the spectrum and facilitate trading, by helping interested parties who do not have access to this spectrum to identify areas where they may provide additional services by trading with licensees in that band.

9.63 We consider that this approach is objectively justified to fulfil our statutory duties and objectives, transparent, proportionate and does not discriminate between licensees.

9.64 We are currently investigating the type and scope of information that it would be useful to provide for this purpose. Therefore, we are particularly interested in the views of stakeholders on what information they think would help to facilitate efficient use of spectrum and secondary trading, and on the impact of the disclosure of this information might have on licence holders. In this respect there are a number of relevant considerations to bear in mind:

[42] *Spectrum Framework Review: Implementation Plan. This document consults on the release of spectrum in 2005 – 08, and on extending spectrum liberalisation and trading to mobile services*, Ofcom, 13 January 2005, http://www.ofcom.org.uk/consult/condocs/sfrip/sfip/sfr-plan.pdf

- The extent to which information provided might fall under the scope of the Environmental Information Regulations;

- The ways in which spectrum usage and spectrum assignments can be compared, in order to identify unused spectrum in a meaningful way to external stakeholders (particularly in comparing cleared and interleaved spectrum usage);

- The wide variety of potential uses of the spectrum concerned, each of which might require different types of transmission network and use different business models to define affected customer bases (e.g. free-to-view broadcast transmissions versus subscriber-based business models);

- The restrictions that might need to be placed on published information to preserve as far as possible appropriate commercial confidentiality and satisfactorily address security concerns;

- The balance which needs to be struck between information which is specific to the digital dividend spectrum and (potentially more limited) information that is comparable across a wider range of bands; and

- The benefits of providing users with as much useful information as possible versus the costs and risks of users providing data, and our aggregating and presenting data in particular formats (e.g. to enable ready geographic comparison of usage and allocation data in particular frequencies).

9.65 In relation to the latter two considerations, we are currently examining the issue of spectrum information provision more widely and plan to publish consultation proposals later this year. However, we will be able to take account of responses to this consultation in developing our more general proposals.

Question 21. We welcome views on the merits of the proposed approach to information provision; in particular concerning the type of information that may be helpful and any impacts that publication of information might have both on licence holders and the wider spectrum market.

Conclusions

9.66 The main specific non-technical conditions that we are currently proposing to include in the WTA licences to be issued as a result of the geographic interleaved spectrum awards are:

- licence term – indefinite, with a initial term lasting to 2026 during which we will have limited rights of revocation;

- provisions for us to revoke licence on spectrum management grounds on any date after expiry of the initial term, subject to 5 years' notice and to apply AIP after expiry of the initial term if appropriate;

- tradability – the licences to be tradable; all legal forms of trading to be permitted;

- a standard licence condition requiring licensees to provide us on request general information regarding their equipment and use of frequencies, or roll out of their network;

- ownership restrictions – local authorities, political bodies, religious bodies, and bodies exerting undue influence will not be permitted to hold licences;

- non-technical restrictions on use – the licences to not restrict the service to be offered or the technology or type of equipment to be used (other than the minimum technical restrictions necessary to control harmful interference); and

- the licences will not contain roll-out obligations or ‘use-it-or-lose-it’ conditions.

Section 10

Promoting competition and efficiency

Introduction and summary

10.1 The DDR statement noted that it would be necessary to consider how awarding this spectrum could best promote competition and efficiency in downstream markets. This section sets out our approach to this assessment, and our proposals for how to ensure that competition and efficiency are best promoted through the award and use of the geographic interleaved spectrum.

10.2 Our recent consultation document concerning the award of the cleared spectrum made a similar assessment of competition and efficiency issues in respect of that spectrum. Given that the geographic interleaved spectrum concerns similar frequency ranges and in principle many (but not all) of the same potential uses of the spectrum, our analysis in this section and Annex 12 is consistent with our analysis in section 9 of that consultation document. Nevertheless our assessment of competition and efficiency issues here in respect of the geographic interleaved spectrum is intended to be readable without reference to our cleared consultation document, and provides references and summary material where applicable.

10.3 Our proposals reflect our belief that the geographic interleaved spectrum provides an important opportunity for the introduction of new services in the UK. This spectrum is valuable because of its position at around 1GHz, combining the benefits of both range (propagation) and capacity (bandwidth) that makes it suitable for many different uses. However, while it is clear that this spectrum is valuable, when considering the significance of competition and efficiency issues it is important to recognise that it is likely to be of lesser value than the spectrum in the cleared award. This is for two reasons. Firstly, compared to the cleared spectrum, the nature of geographic interleaved spectrum means that the use of this spectrum may be less versatile than spectrum offered in the cleared award. This is in part because it is a patchwork of frequencies across a number of geographic locations. Secondly, in each location we are proposing to auction perhaps 8 MHz to 16 MHz compared to 128 MHz to be made available via the cleared award.

10.4 Nevertheless, as set out in sections 4 and 5, this spectrum can form the building blocks for a number of services (such as, but not limited to, local and regional broadcasting) which are potentially of significant value to UK citizens and consumers. Our approach to its award can influence the market structure which emerges as a result of the award. Generally, the more competitive the market structure, the lower the level of market power held by firms in the market, and as a result the more competition and efficiency are promoted. Hence, it is important for us to take particular care to ensure that our approach achieves these goals. As explained below, the promotion of competition and efficiency is important for ensuring that total value to society is fully realised.

10.5 Because of this, promoting competition and efficiency are always important considerations when we are awarding spectrum, and more generally in our approach to spectrum management. The link between competition and efficiency considerations and our duties is set out in section 3. In addition, these and other

duties which are relevant to our spectrum management activities are discussed in the Spectrum Framework Review[43].

10.6 In this section we explain:

- why we think competition and efficiency are important for promoting citizen and consumer value from the use of spectrum;
- how our approach to awarding and managing spectrum is designed to promote both competition and efficiency;
- how this approach should be applied in the context of the geographic interleaved awards, this includes consideration of whether there are specific risks of market failure (which through their impact on market structure would impact on the promotion of competition and/or efficiency) that might require us to take tailored action in relation to any particular potential use of the geographic interleaved spectrum.

10.7 The key conclusions reached in this section are set out in the following paragraphs.

10.8 We believe that the first step in promoting competition and efficiency in the geographic interleaved awards should be through the design of the spectrum awards. This includes for example, using auction design and packaging to help to promote a market structure which furthers competition and efficiency, for example, by enabling entry by new operators (where this is efficient) and by reducing as far as possible asymmetries between bidders which might unduly impact upon their ability to reflect their demand for spectrum.

10.9 We have considered whether there may be a case for us to go beyond this to promote competition and efficiency either by putting in place general safeguards or by intervening to resolve significant risks of market failure which could impact on the market structure which emerges as a result of the award. When considering the case for such intervention we need to pay attention to the costs and benefits of intervention, including the risk of regulatory failure (i.e. the costs imposed if the intervention has unintended consequences) and also take into account that, after the award of spectrum, we retain the ability to resolve significant competition concerns which emerge in downstream markets through our sectoral and competition powers.

10.10 In relation to any general safeguards, we identified that the following provision might be appropriate given the importance of the spectrum:

- An information provision licence condition which would help reduce information asymmetries between spectrum users and help to facilitate an efficient secondary market. This information provision is discussed below and in section 9.

10.11 In order to identify whether there are specific issues in relation to individual potential uses of the geographic interleaved spectrum which could result in a significant risk of market failure, we have examined the potential uses of the geographic interleaved spectrum, and the potential for their acquisition of spectrum to result in a market structure in which competition and efficiency are not promoted. This analysis has identified a number of potential market failure issues.

[43] See http://www.ofcom.org.uk/consult/condocs/sfr/sfr/sfr_statement

10.12 However, our initial view is that these issues do not require action in the award of the geographic interleaved spectrum as the issues are either not sufficiently significant to warrant action (given the costs and risks of intervention on efficient spectrum use), or (if they emerge as significant issues) are better resolved through other forms of intervention.

10.13 In summary, it is important that the geographic interleaved awards promote both competition and efficiency in the award and use of this spectrum. We believe that our award processes will go a long way towards this. We consider in the remainder of this section whether there is a case for us to go further in terms of putting in place general safeguards or other specific interventions to secure these goals. We conclude that one general intervention may be appropriate; this is an information provision licence condition that will help facilitate an efficient secondary market. We are particularly interested in views from stakeholders regarding our approach either in general or in relation to the specific issues considered in this section.

Why competition and efficiency are important

10.14 Spectrum is a very valuable resource and is a key input to a wide variety of services. In aggregate spectrum underpins around £37 billion of UK economic activity, equivalent to around 3 per cent of UK annual economic output[44]. It supports a number of services which are of value to society, including mobile communications and broadcasting. Spectrum is likely to remain an important input to these kinds of services in the future and innovation and technological development of services are likely to see the demand for spectrum enhanced.

10.15 Promoting competition through the use of spectrum is important as consumers are likely to benefit through lower prices, and/or higher service quality and innovation where services are provided in a more competitive environment (i.e. where individual players hold less market power). As spectrum is a key input to the provision of many important communications services a more competitive market structure for the provision of these services will be fostered where spectrum is available to service providers in a competitive manner. Auctions for spectrum in the UK have in general facilitated more competitive market structures by, among other things, encouraging new entry.

10.16 Promoting efficiency through the award and use of spectrum is important as citizens and consumers will benefit where spectrum is used efficiently. Given the value of services which are dependent on spectrum, not to use spectrum efficiently would risk depriving citizens and consumers of services that might otherwise have been provided, and could potentially impede UK productivity and economic growth. Inefficient spectrum use could include a service provider not fully using all of the spectrum they have acquired and not trading any leftover spectrum with others who could make better use of it, either because they fail to recognise this opportunity or because of undue difficulties in trading.

10.17 The promotion of competition and efficiency are to some extent linked. Competition in the provision of services will tend to promote efficiency in downstream markets by giving operators incentives to innovate and to provide services more cost effectively, for example by ensuring that the minimum amount of spectrum is used to produce the desired level of output. In some situations there may be a trade off between competition and efficiency, for example, when a market is already relatively competitive it can sometimes be the case that additional entry is inefficient. This can

[44] See http://www.ofcom.org.uk/research/radiocomms/reports/economic_spectrum_use/

happen when entry results in additional fixed costs which outweigh the competition benefits of entry (as these tend to decline the more firms in the market). However, in the majority of cases, promoting competition will also promote efficiency.

Three step approach to promoting competition and efficiency in the geographic interleaved awards

10.18 The introduction of a market led approach to spectrum management is motivated by our desire to improve efficiency and competition both in the spectrum market itself and in markets for services reliant on spectrum.

10.19 A market led approach to spectrum management helps to promote competition and efficiency since, when markets work well, they help to reveal information and provide incentives which promote efficiency. Additionally, a market led approach can help to reduce barriers to entry by reducing restrictions on spectrum use which helps to make spectrum more substitutable, and so promotes more competitive market structures by making new entry easier.

10.20 However, these features of a well functioning market will not always emerge. This is because markets sometimes fail. There are a variety of market failures which can arise when spectrum is managed through a market led approach, and it is important for us to take these into account, as it is possible to reduce the risk of market failure by adapting the approach to reflect these risks.

10.21 Examples of potential market failures which could have a significant impact upon whether a market led approach promotes competition and efficiency are provided below:

- In some situations it is possible for the holding of spectrum in particular frequency ranges to be crucial for the provision of goods or services in a particular downstream market. Where holding of this spectrum is concentrated in a few hands, competitors may be impeded from entering the market for the downstream services, and so the resulting market structure is one in which competition is not promoted fully. The potential competitive advantages of spectrum holding in this situation, owing to the barrier to entry it represents, may provide a motivation for a party to acquire and hoard spectrum, with the intention purely of denying its use to others, and hence preventing the emergence of a more competitive market structure. These incentives can arise even if the market is not characterised by single or collective dominance (under the tests defined in competition law), but the risk of such behaviour is likely to diminish the more competitive the market and hence the less the market power held by individual market players.

- Secondary trading of spectrum is an important mechanism for parties to optimise their spectrum holding and use patterns according to market circumstances and in response to technological developments. However, the emergence of efficient spectrum trading depends on the extent to which both current and prospective spectrum owners have relevant information about spectrum in the market and the uses to which it is being or can be put. A lack of relevant publicly available information can result in a market failure which impacts on spectrum efficiency because it impedes price formation, spectrum acquisition and hence efficient spectrum use.

10.22 In considering our proposals for the cleared and the geographic interleaved awards we have used a three step approach to reducing the risk of market failure. The first

step involves using auction design and packaging to try and set the foundations for a well functioning market, and to bring about (where relevant) a market structure that furthers competition. The next two steps in the process involve considering whether or not to impose varying forms of regulatory intervention, to reflect the risk that, given the nature of the spectrum and its uses, it may not be possible to achieve a well functioning market through appropriate award design alone. In summary, the three steps can be described as follows:

- The first step involves using auction design and packaging to promote competition and efficiency. For example, the auction can be designed in order to help to reveal information which can minimise the ability of participants to behave strategically to manipulate the outcome of the award process. This step can often go a long way towards achieving an outcome where a well functioning market, with a market structure that furthers competition, emerges without imposing significant costs on participants. This is because this approach generally works by removing barriers that may prevent the market from working, but does not involve substituting regulatory decisions for the outcome of the market. However, in some situations, for example, when the spectrum under consideration is particularly valuable and there are limited substitutes, these provisions alone may not be enough to ensure that a well functioning market emerges.

- The second step involves considering whether there is a need for general safeguards to provide spectrum holders with sharper incentives to use spectrum efficiently and to promote competition through bringing about a more competitive market structure. These safeguards would apply to all spectrum holders irrespective of the use to which they put the spectrum. These remedies would generally involve imposing regulatory judgement on the outcome of a market and can impose significant costs if this judgement proved to be incorrect. As a result, we need to consider the costs and benefits of these interventions carefully before deciding to act.

- The third step involves identifying whether there are potential uses to which spectrum could be put which raise specific market failure risks, and identifying whether targeting intervention designed to help to ensure that the award brings about a more competitive market structure would be an appropriate regulatory response to such risks. As with the general remedies mentioned under step two above, remedies imposed to forestall or alter such risks impose regulatory judgement on the outcome of a market, and hence it is important to consider the costs and risks involved to ensure that these do not outweigh the likely benefits of intervention.

10.23 If these steps are either insufficient to remedy any problem, or if, owing to uncertainty over the market outcome, the costs of pre-emptive intervention are too high to justify action, we have general sectoral and competition powers that enable us to address certain competition concerns if they emerge.

10.24 As we discussed earlier, we have a principal duty to promote competition where appropriate, which is a related but nevertheless separate concept to addressing anti-competitive behaviour where it occurs. Our spectrum awards to date have illustrated how auctions can promote competition through allowing new entry and bringing about more competitive market structures. This is one reason why we are potentially concerned about situations where the presence of some level of market power (even in cases where this level of power is below that which would imply dominance) may create the conditions for the award of spectrum (absent intervention) to fail to bring about more competitive market structures. Hence, in summary, given our duty to

promote competition, we are concerned by award outcomes where the likely market structures are less competitive compared with what they were or could have been under different award outcomes. And where these likely market structures result in market players having a degree of market power (even though this does not in itself suggest that a dominant position and anti-competitive behaviour will emerge).

10.25 In the 2006 DDR consultation document and 2007 DDR statement we carefully considered the risk of the award of the digital dividend resulting in a market failure which might suggest the need for us to depart from a market led approach, and identified an analytical approach for assessing these issues. This analytical approach involves identifying and trading off the benefits of resolving the market failure with the costs of the intervention and the risks of regulatory failure. In this section we apply this framework to assess the potential for market failures which could impact upon whether the use of the geographic interleaved spectrum assigned through auction promotes competition and efficiency. This does not mean that we are re-opening our assessment of whether a market led approach is the best way to maximise the total value to society generated by the use of the spectrum over time, but recognises that in facilitating markets (i.e. through our auction design) we face choices which impact upon the likelihood of these markets achieving a successful outcome that promotes competition and efficiency, for example, by helping to ensure that (where possible) more competitive market structures emerge.

10.26 In the remainder of this section we apply each of the three steps set out above to the geographic interleaved awards to identify how best to promote competition and efficiency through these awards.

Question 22. Do you agree with our approach to assessing whether the awards of geographic interleaved spectrum fully promote competition and efficiency?

Question 23. Do you have particular concerns about possibilities for award outcomes to fail to fully promote competition in downstream markets or to result in inefficient use of spectrum? If so, please explain what these are and provide supporting evidence.

Step one - using packaging and auction design to promote competition and efficiency

10.27 We consider next how decisions over packaging and auction design can help to create the foundations for a well functioning market that supports the development of competition, and hence, promotes competition and efficiency. We have taken the conclusions of this analysis into account in sections 6 and 7.

10.28 In relation to packaging, we considered how this can impact upon possible outcomes of the award process and the consequences for competitive market structures both in the spectrum market itself and associated downstream markets. There are a number of ways in which our packaging proposals promote competition and efficiency, for example:

- We can package the spectrum into sufficiently small units such that interest in participating in the auction is maintained for all bidders.
- We can package the geographic interleaved spectrum such that it can support a variety of uses.

- We can maximize opportunities for bidders to aggregate or substitute lots, or to put spectrum to different downstream uses, by packaging frequency channels separately for any one transmitter.

10.29 In relation to auction design there are a variety of ways in which this can be used to promote competition and efficiency, for example by:

- maximising the incentives on participants to bid their true value for the spectrum;
- minimising incentives and possibilities for strategic behaviour by bidders aimed at excluding other bidders or reducing prices paid; and
- maximising opportunities to participate and hence facilitate efficient new entry (e.g. by phasing the auctions).

10.30 We have taken these into account in identifying our proposed auction format for the first phase of the geographic interleaved spectrum award – an ascending bid auction – which includes a number of relevant features designed to assist in the efficient allocation of spectrum and encourage competitive entry. These features are set out in the discussion of the auction rules in section 7 and include:

- The use of a second price rule which encourages bidders to bid their true value for spectrum, because they can be sure that if this is a winning bid, they will have obtained an asset with some level of value to them (equal to their bid less the next highest bid). If bidders were not to bid their true values but instead to shade their bids below their true value, this would risk inefficient outcomes.
- Rules on bidder association aimed at prohibiting collusive coalitions of bidders, or collusion concerning the bidding process itself.
- The extent to which information about bidders and bids is revealed throughout the auction process. These rules can aid price discovery, by addressing common value uncertainty. However, if too much information is revealed this can increase the risks of collusion or inappropriate tactical bidding or influencing.
- Participation rules and payment processes that aim to enable a wide participation in the award.

10.31 Our initial views concerning the auction format for the combined award also take into account the need to promote competition and efficiency. There is for an example an explicit need to take into account aggregation risk and allow all bidders to express their interest in buying lots either for aggregation or on standalone basis. Our view that a CCA format is preferable rests to a significant extent on this need.

10.32 We will also take the promotion of competition and efficiency into account when proposing appropriate auction proposals for final phase of awards.

10.33 In summary, we think these proposals and intended approach will go a long way towards fostering competition and efficiency in the geographic interleaved award. However, in the remainder of this section we go on to consider whether further regulatory action may be required.

Step two - general provisions to promote competition and efficiency

10.34 In this section we consider whether there may be a case for general regulatory remedies to promote further competition and efficiency. This section provides our conclusions on the application of general remedies to the geographic interleaved awards, the detail of our analysis is set out in Annex 12.

10.35 Any general remedies would apply to all of the potential uses of the geographic interleaved spectrum and would seek to sharpen the incentives of spectrum holders to use spectrum efficiently and to promote more competitive market structures. They would not therefore be made with reference to particular issues that might concern particular uses of the geographic interleaved spectrum; these are considered under our third step below.

10.36 We also note in this context that a number of respondents to the DDR consultation document raised questions around competition issues and some suggested potential general remedies. Taking these into account, we have considered and concluded on the application of the following general remedies in the geographic interleaved awards:

- Use it or lose it requirements – these would involve using licence conditions to ensure that spectrum licensees do not hold spectrum idle.

  We do not propose to introduce this remedy in the geographic interleaved awards. The key reason for this is because this remedy tends only to be effective where spectrum is demonstrably idle for inefficient reasons. Where these conditions are not met, this remedy risks forcing use of spectrum where it is not yet efficient to do so.

- Rollout obligations – these would ensure that spectrum holders rollout services to a certain minimum extent.

  We do not propose to introduce this remedy in the geographic interleaved awards. The key reasons for this are because, the market failure which rollout obligations are designed to resolve (i.e. socially sub-optimal levels of coverage), is not one which we think is likely to be a significant issue for the geographic interleaved spectrum, given how it is likely to be used. And because, even if this form of market failure were to occur, we think that rollout obligations are unlikely to be the best remedy for this. Direct funding can achieve the same benefits in a more cost effective manner.

- Information provisions – these would work to ensure that there is information available to the market on spectrum holdings, the aim of which is to remove potential barriers to efficient secondary markets.

  We see merits in this remedy since it tends to promote secondary trading, price formation, and hence efficient spectrum use. The disadvantages of such a remedy are relatively limited and primarily concern commercial confidentiality issues. We consider therefore that such a remedy could have general merit.

- Access requirements – these would involve placing conditions in licences that would require spectrum holders to provide access either to the spectrum they hold or to the networks they build using this spectrum in order to further remove barriers to entry, and promote more competitive structures in downstream markets.

We do not propose to introduce this remedy in the geographic interleaved awards. We do not think that there is a competition or efficiency issue which could be resolved by access requirements which applies across all of the likely uses of the geographic interleaved spectrum. Hence, the benefits of a general remedy are unclear. Additionally, this approach tends to be most effective where the spectrum uses to which access conditions might apply are reasonably well foreseen, although even here, access requirements must be carefully designed. Where the nature of the access issue is unclear or uncertain (as for the geographic interleaved spectrum) this remedy can be costly, as for example, there are significant risks of unintended consequences.

- Spectrum caps – these would involve placing limits on the amount of spectrum that any one licensee can hold. The purpose of this would be to ensure that spectrum holdings are not heavily concentrated (i.e. that the award does not result in a very small number of players holding all of the spectrum), and hence more competitive market structures are promoted.

  Remedies of this type can have general benefits in that they can promote diversity of spectrum holdings and so can help to facilitate secondary trading and market entry. However risks include that spectrum caps set too tightly prevent efficient entry and spectrum use in the first instance. Concerning the geographic interleaved spectrum, we consider that such risks will tend to outweigh any such benefits.

10.37 Annex 12 includes our detailed considerations for each of these remedies.

10.38 Overall we propose that, in respect of the geographic interleaved awards, it may be appropriate to introduce an information licence condition. This would require the provision of information related to spectrum holdings and use, with the intent of placing this in the public domain. It would be aimed at enabling existing and prospective spectrum holders to evaluate the potential uses and value of spectrum, and so promoting efficient price discovery, secondary trading, and efficient spectrum use. Section 9 discusses the issues affecting the detailed drafting of a general information provision licence condition, and seeks views.

10.39 We do not at this stage propose, for the reasons set out above and in Annex 12 to introduce any other general remedies.

10.40 We recall in this context that for the cleared award, we have proposed (along with an information provision licence condition) a general remedy of a safeguard spectrum cap of 50 MHz. For the reasons set out in Annex 12 we do not at this stage see a strong case for extending the scope of such a spectrum cap to include the award of geographic interleaved spectrum. We remain however open to views.

Summary of first two steps to promoting competition and efficiency in the geographic interleaved awards

10.41 Therefore in summary the first two steps in our approach to promoting competition and efficiency in the award and use of the geographic interleaved spectrum have resulted in the following conclusions:

- We are proposing to use auction design and packaging as the starting point for the promotion of competition and efficiency. Our proposals for packaging and auction design were set out in sections 6 and 7 respectively.

- We are also proposing an information provision licence condition which aims to put into the public domain information about spectrum holding and use in order to facilitate secondary trading. We have discussed the issues affecting the detailed drafting of such a condition in section 9.

- We are not proposing use it or lose it, rollout conditions, general access conditions, or a spectrum cap.

Question 24. Do you agree with our proposals to include an information provision licence condition to help facilitate efficient secondary trading?

Question 25. Do you agree with our view that we should not apply any general remedies other than for information provision in the geographic interleaved award?

10.42 In the next section we consider whether there are specific market failure risks which might require us to take tailored action in relation to any particular potential use of the geographic interleaved spectrum.

Step three - specific issues considered by the competition and efficiency assessment

10.43 We set out here the process we have followed in analysing and identifying particular competition and efficiency considerations that might arise as a result of particular outcomes of the geographic interleaved spectrum award which have the potential to result in market structures which could have been more competitive if we had intervened (i.e. which fail to fully promote competition). Where these situations are identified we think they merit specific consideration as they may require intervention above and beyond that given by packaging and auction design and the more general remedies discussed under steps 2 and 3 respectively.

10.44 Our analysis has focused on three broad downstream markets: broadcasting, mobile broadband, and mobile multimedia. As discussed in section 4, and in our earlier DDR documents, these encompass the most likely potential uses of the geographic interleaved spectrum.

10.45 For each broad downstream market, we considered a wide range of spectrum award outcomes in order to assess the likelihood and significance of market structures emerging, absent intervention, that may fail to fully promote competition, and the significance of such an outcome for consumers and the competitive process more generally.

10.46 Our assessment was forward looking and necessarily to some extent speculative. The three downstream markets considered are rapidly developing and subject to a considerable degree of uncertainty. Any intervention or remedy posited in order to promote more competitive market structures will carry its own risks and/or costs. This means that we need to be careful when identifying market structures which could in principle be more competitive and, when we do identify such outcomes, in proposing any remedies for them.

10.47 For this reason, our analysis has sought to focus on outcomes where the potential market structure could be more competitive, and where, if this were the case, consumer benefits could be significantly higher. In principle, where these outcomes occur, we would go on to consider whether there are available remedies which can promote more competitive market structures without imposing unreasonable costs, noting that we might be prepared to accept a higher cost or risk from a remedy where

it is likely to promote a significantly more competitive market structure. We have also considered the extent to which competition considerations attached to certain spectrum award outcomes might better be addressed in ways other than intervening in the spectrum award itself.

10.48 In identifying outcomes where we could help to bring about a more competitive market structure if we were to intervene further, we have given particular attention to markets where we are aware of recent and/or ongoing analysis in relation to whether the current (or likely future) market structure is consistent with the promotion of competition.

10.49 The table below sets out the full set of issues we have considered (based on the potential uses and the likelihood of an outcome occurring which could in principle have an impact on market structure) and highlights two issues which we identified as sufficiently important to require consideration of whether there is a case for applying a remedy in the geographic interleaved award.

Table 10.1 Scenarios considered to identify outcomes when the market structure could be more competitive

Description of possible spectrum award outcome	Potential impact on market structure	Analysis
Broadcasting		
Sky purchase of geographic interleaved spectrum for aggregation into sub UK mux for pay TV services	- If Sky were found to have market power in premium pay TV and related markets, then this could create the potential for an acquisition by Sky of DDR spectrum to potentially foreclose the development of more competitive market structures, for example by limiting the ability of other competitors to access terrestrial broadcasting capacity	- The Pay TV market investigation consultation document[45] set out concerns regarding effective competition in the pay TV industry. Given this we think that we need to consider carefully the potential for Sky to acquire DDR spectrum in order to identify whether, because of Sky's market position, this could impact on the promotion of competition or efficiency as a result of the award of the geographic interleaved spectrum (i.e. whether this could result in a market structure which could be more competitive) - Therefore, **this issue is considered further below**
ITV acquisition and aggregation of geographic interleaved spectrum to deploy additional DTT multiplex(es)	- Could potentially allow ITV to strengthen its position in the national TV advertising market	- Given the presence of the Contract Rights Renewal (CRR) remedy, and given the current OFT/Ofcom review[46] of this remedy, **we do not think this issue is sufficiently significant to warrant consideration of separate action**

[45] See http://www.ofcom.org.uk/consult/condocs/market_invest_paytv
[46] See http://www.oft.gov.uk/advice_and_resources/resource_base/register-orders-undertakings/reviews/CRR-review

		in the award of the geographic interleaved spectrum
NGW/Arqiva acquire and aggregate geographic interleaved spectrum to deploy additional DTT multiplex(es)	- Spectrum acquisition could potentially result in a player with a greater degree of market power over the DTT multiplex capacity market in addition to market power over upstream services (i.e. managed transmission services) and as a result more competitive market structures may have been precluded	- We consider that this is an issue that requires careful consideration - Therefore, **this issue is considered further below**
PSBs (other than ITV) purchase and aggregate geographic interleaved spectrum to deploy additional DTT multiplex(es)	- Could increase their market share in terms of DTT capacity - Has the potential to exclude new entrants, and other downstream broadcasters, and hence fail to result in a more competitive market structure	- There is little evidence to suggest that the PSBs acquisition of geographic interleaved spectrum would preclude better market structures arising, and for this to have resulted in significantly lower benefits for consumers than would otherwise be the case - **We do not think this issue is sufficiently significant to warrant consideration of separate action in the award of the geographic interleaved spectrum**
Mobile broadband		
Geographic interleaved spectrum is purchased to provide or supplement 3G or Next Generation Mobile (NGM) network (i.e. LTE or WiMAX)	- The advantages of low frequency spectrum, combined with its limited availability for these services, limits the number of networks that can be deployed using these frequencies - As a result, the market structure which emerges may be one in which the acquirer(s) of the DDR spectrum suitable for mobile broadband have an enhanced market	- The characteristics of geographic interleaved spectrum mean that any broadband services deployed through it are more likely to be supplements to, rather than full substitutes for, mobile broadband services provided through DDR spectrum in general. Any acquisition of a significant portion of geographic interleaved spectrum for mobile broadband use is therefore unlikely to have a significant impact upon the market structure which emerges in the future mobile broadband market - **We do not think this issue is sufficiently significant to warrant consideration of separate action in the award of**

	position than other potential players in this market	**the geographic interleaved spectrum**
Mobile Multimedia Services (MMS)		
A Mobile Network Operator (MNO) (or a consortium of MNOs) purchases and aggregates geographic interleaved spectrum in order to provide network for own MMS service, or to provide a wholesale network service	- Potential to establish market structures which are less competitive than they could otherwise have been (i.e. could result in a vertically integrated monopoly in the provision of MMS services at either the retail or wholesale level, at least in short term);	- The availability of substitute spectrum and possibilities for consumers to access mobile broadcast and other content through other means (e.g. content download on 3G) means the market structure is unlikely to be determined by the outcome of the geographic interleaved award, and that sufficiently competitive market structures are relatively likely to emerge **- We do not think this issue is sufficiently significant to warrant consideration of separate action in the award of the geographic interleaved spectrum**
A broadcaster purchases and aggregates geographic interleaved spectrum in order to provide own use end-to-end MMS service	- Broadcaster control of content has the potential to allow a market structure to emerge in which competition is not fully promoted	
A broadcaster purchases and aggregates geographic interleaved spectrum in order to operate a network and to provide a wholesale network services to other MMS providers	- Broadcaster has the potential to establish a strong market position in the wholesale provision of MMS network services, and this precludes the development of more competitive market structures	

10.53 The high level summary of our assessment of possible spectrum award outcomes and the potential for these to result in market structures which could be more competitive highlights that, in most cases, we concluded that any concerns about the likely market structure were not sufficiently significant to warrant further consideration.

10.54 However, our assessment identified two particular issues for which we consider that there is sufficient potential for the market structure to be less competitive than it might otherwise have been. These are:

- Pay TV – Sky acquisition and aggregation of geographic interleaved spectrum for pay services on DTT; and

- NGW/Arqiva[47] – acquisition and aggregation of geographic interleaved spectrum for additional multiplexes on DTT.

10.55 We have considered further these two issues in order to identify whether targeted intervention in the geographic interleaved award may be warranted. Our full consideration of these issues is included in Annex 12. The following paragraphs summarise our considerations.

10.56 Regarding Sky, we have considered whether a potential acquisition of geographic interleaved spectrum by Sky in order to launch pay TV services on the DTT platform could result in a market structure which fails to fully promote competition. As discussed in Annex 12, within the last year we have published two consultation documents which have raised issues in relation to the potential for Sky to have market power[48], primarily in relation to the potential existence of any wholesale markets for premium content (likely to include first run Hollywood movies and particular types of sports content). If Sky does have has market power over wholesale markets for access to premium content, it is possible that an acquisition of geographic interleaved spectrum, coupled with control of premium content, could raise competition concerns around the potential to foreclose further development of competition in terrestrial broadcasting, and the potential to leverage any possible market power arising from control of premium content into retail markets across platforms. Both of these effects, were they to occur, could prevent the emergence of more competitive market structures. However, we recognise that any concerns arising from these are likely to be less than the concerns which may arise from a potential acquisition of cleared spectrum by Sky, given the more limited coverage afforded by geographic interleaved spectrum.

10.57 However, overall we see the question of access to premium content as the central issue in relation to the potential for there to be competition concerns arising in relation to Sky's market position. This issue is not primarily linked to the potential for Sky to acquire geographic interleaved spectrum, or to the impact this might have on market structure. This would suggest that any competition concerns are best pursued through our existing initiatives concerning Sky's 'Picnic' proposal and our wider review of the pay TV market. However, we recognise that we may need to keep this under review.

10.58 Regarding NGW/Arqiva, a scenario that could arise as a result of the geographic interleaved award is the acquisition by NGW/Arqiva of spectrum for use for one or more further commercial DTT multiplexes. This could in principle increase the share this entity has of the provision of multiplex services to commercial broadcasters from two out of three to three out of four or greater and so adversely affect parties seeking wholesale multiplex services. However, the likelihood and significance of adverse effects arising from such an outcome will tend to be ameliorated both by possibilities for such parties to find alternative carriage on other DTT multiplexes and or other broadcasting platforms, and by the fact that any such new multiplexes provided through geographic interleaved spectrum are likely to be constrained in coverage. Furthermore, we note that, if these were to raise competition concerns imposing remedies in the geographic interleaved award, such as a prohibition on the acquisition of spectrum, could risk a number of unintended consequences such as

[47] In April 2007, Arqiva's owner Macquarie UK Broadcast Ventures Limited acquired NGW. In this analysis we consider the impact of the merged entity acquiring geographic interleaved spectrum.
[48] These are firstly our Pay TV market investigation (see: http://www.ofcom.org.uk/consult/condocs/market_invest_paytv) and secondly, our assessment of Sky's 'Picnic' proposal (see: http://www.ofcom.org.uk/consult/condocs/dtv/)

the loss of opportunities the acquisition might afford for economies of scale or scope or missed opportunities to allow enhanced coordination abilities.

10.59 Hence, overall, taking into account the uncertainty over whether a competition concern would arise (i.e. whether a market structure which fails to fully promote competition could emerge) and the significant risks involved in seeking to remedy this in the geographic interleaved award, we take the view at this stage that we should not intervene in the award in relation to the potential for NGW/Arqiva to acquire geographic interleaved spectrum. As a separate issue, we note that in the case that any anti-competitive behaviour were to arise, we would be able to seek to resolve this through our regulatory or competition powers as appropriate.

Question 26. Do you agree with our initial assessment that we should not intervene in the geographic interleaved award to remedy any potential impact on competition resulting from the holding of geographic interleaved spectrum by either Sky or NGW/Arqiva?

Conclusions

10.60 In this section we have explained why it is important to consider the impact of the geographic interleaved award on competition and efficiency in downstream markets, and how our approach to the award aims at achieving this goal.

10.61 Our starting point for promoting competition and efficiency is to use the primary award process (i.e. packaging and auction design) to, for example, maximise the incentives on participants to bid their true value for the spectrum, minimise incentives and possibilities for strategic behaviour by bidders aimed at excluding other bidders or reducing prices paid, and maximise opportunities to participate and hence facilitate efficient new entry.

10.62 In addition, we have considered whether there is a case for general remedies which could further promote competition and efficiency. After considering the following remedies: use it or lose it requirements, rollout obligations, information provisions, access requirements, and spectrum caps, we have reached the initial view that in order to promote opportunities for secondary trading, and hence efficient spectrum use, we should facilitate the provision of information concerning spectrum holding and use by imposing an information provision licence condition.

10.63 We noted our proposal for a general safeguard spectrum cap of 50 MHz for the cleared award, as discussed in our June 2008 cleared award consultation document[49]. We do not at this stage see a strong case for extending the scope of such a spectrum cap in the cleared award to include the award of geographic interleaved spectrum.

10.64 We have also considered a number of specific market failure risks where we felt that the award outcome had the potential to result in a market structure which may not fully promote competition. These outcomes included:

- the potential for Sky to purchase and aggregate geographic interleaved spectrum to rollout a DTT multiplex and to use this to enter the terrestrial broadcasting market, and the potential for this to have a resulting impact on the emergence of more competition in broadcasting markets, and

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

- the potential for NGW/Arqiva to purchase and aggregate geographic interleaved spectrum in order to rollout an additional DTT multiplex, and the potential for this to increase its share of the provision of wholesale multiplex services.

10.65 We do not however at this stage believe that the potential purchase of geographic interleaved spectrum by Sky or NGW/Arqiva, in order to operate one or more DTT multiplexes, raise issues that should be addressed through the geographic interleaved award.

Section 11

Next steps

11.1 This consultation, published on 12 June 2008, lasts for a 10-week period. The closing date for responses is 21 August 2008. See Annex 1 for details of how to respond to this consultation.

11.2 We are planning to hold a seminar on our proposals during the consultation period.

11.3 When the consultation has closed, we will undertake a comprehensive review of responses and factor this into our decision on the best way to progress the proposed awards. We will then confirm next steps.

The initial phased award

11.4 We are proposing that the initial phased award of lots for Caldbeck, Winter Hill and Wenvoe will take place in late 2008 or early 2009. We will finalise the details of the award in the light of responses to this consultation.

11.5 We will publish an Information Memorandum for the award. This will be designed to give bidders as much information as necessary for them to decide whether to enter the auction and how they would prepare for participation. It may be modified or complemented by the publication of updates and answers to specific questions.

11.6 Regulations will provide the legal basis for the auction and contain detailed and comprehensive rules and procedures for its running. The regulations are made by means of a statutory instrument. They must be published in draft with a minimum of 28 days allowed for comments. When all comments have been considered and necessary amendments made the regulations are made in final form; they come into force 21 days after being made.

11.7 Our provisional timetable suggests that both the Information Memorandum and the draft regulations should be published at the same time later in 2008.

The combined award

11.8 We are proposing a combined award of ‘large’ lots in the locations identified as being most suitable for aggregation. This award would take place soon after the award of the cleared spectrum, which is scheduled to begin in summer 2009.

11.9 The proposals for this award raise a number of issues, particularly in relation to the auction design discussed in section 7. Following our analysis of responses we expect to hold a further consultation on these issues later in 2008.

Further phased awards

11.10 We are proposing possible phased awards of ‘medium’ and ‘small’ lots in early 2010 and in early 2011, ahead of the latter stages of the DSO timetable, subject to evidence of demand. Following our analysis of responses to this we expect to hold a further consultation on these issues later in 2008.

Timetable for the awards

11.11 The table below sets out our current timetable for holding the geographic interleaved awards.

Table 11.1 Timetable for the geographic interleaved awards

Date	Activity
June 2008	First consultation on detailed award design
August 2008	First consultation closes
Early Autumn 2008	Information Memorandum and draft regulations for the initial phased award of medium lots for Carlisle, Cardiff and Manchester.
Late Autumn 2008	Second consultation on detailed award design for combined award. Second consultation on further phased awards.
Late 2008 or early 2009	Initial phased award. Second consultation closes
Late Spring 2009	Information Memorandum and draft regulations for combined award.
Autumn 2009	Combined award.
Early 2010	Phased award for medium and small lots
Early 2011	Phased award for medium and small lots

Annex 1

Responding to this consultation

How to respond

A1.1 Ofcom invites written views and comments on the issues raised in this document, to be made **by 5pm on 21 August 2008**.

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

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

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

DDR Geographic Interleaved Project Team
Spectrum Policy Group
Third floor
Riverside House
2A Southwark Bridge Road
London SE1 9HA

Fax: 020 7783 4303

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

A1.6 It would be helpful if your response could include direct answers to the questions asked in this document, which are listed together at Annex 4. It would also help if you can explain why you hold your views and how Ofcom's proposals would impact on you.

Further information

A1.7 If you want to discuss the issues and questions raised in this consultation, or need advice on the appropriate form of response, please contact Joe Sonke on 020 7783 4345.

Confidentiality

A1.8 We believe it is important for everyone interested in an issue to see the views expressed by consultation respondents. We will therefore usually publish all responses on our website, www.ofcom.org.uk, ideally on receipt. If you think your response should be kept confidential, we ask you to specify what part or whether all of your response should be kept confidential, and to tell us why. If you wish parts of

your response to be kept confidential, please place them in a separate annex to your response.

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

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

Next steps

A1.11 Following the end of the consultation period, Ofcom intends to publish a statement in autumn 2008.

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

Ofcom's consultation processes

A1.13 Ofcom seeks to ensure that responding to a consultation is easy as possible. For more information please see our consultation principles in Annex 2.

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

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

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

Tel: 0141 229 7401
Fax: 0141 229 7433

Email vicki.nash@ofcom.org.uk

Annex 2

Ofcom's consultation principles

A2.1 Ofcom has published the following seven principles that it will follow for each public written consultation:

Before the consultation

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

During the consultation

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

A2.4 We will make the consultation document as short and simple as possible with a summary of no more than two pages. We will try to make it as easy as possible to give us a written response. If the consultation is complicated, we may provide a shortened Plain English Guide for smaller organisations or individuals who would otherwise not be able to spare the time to share their views.

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

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

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

After the consultation

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

Annex 3

Consultation response cover sheet

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

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

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

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

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

Cover sheet for response to an Ofcom consultation

BASIC DETAILS

Consultation title:

To (Ofcom contact):

Name of respondent:

Representing (self or organisation/s):

Address (if not received by email):

CONFIDENTIALITY

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

Nothing ☐

Whole response ☐

Part of the response ☐

Name/contact details/job title ☐

Organisation ☐

If there is no separate annex, which parts?

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

DECLARATION

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

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

Name

Signed (if hard copy)

Annex 4

Consultation questions

Question 1. The executive summary sets out our proposals for the digital dividend geographic interleaved award. Do you agree with these proposals?

Question 2. Do you have any comments on our assessment of the most likely uses of the geographic interleaved lots? Are there any potential uses which should be considered that we have not mentioned?

Question 3. Are there any other types of DTT transmission that should be protected from potential cognitive devices or other factors that we should take into account?

Question 4. Are there any potential future PMSE applications, other than currently available wireless microphones, in-ear monitors and talkback systems, that you consider should be protected from potential cognitive devices?

Question 5. Is there sufficient evidence to require protection for other services such as mobile television, bearing in mind the potentially negative implications of such protection for deployment of cognitive devices?

Question 6. What levels of coverage and aggregation are of interest to you?

Question 7. Do you agree that the median option offers an acceptable balance between protecting reception of DTT services and maximising new DTT services using geographic interleaved lots?

Question 8. Do you agree with the proposal for a series of awards of spectrum lots - an award of lots for Caldbeck, Winter Hill and Wenvoe in late 2008 or early 2009, a single award in 2009 of large lots and awards of lots for other locations linked to DSO?

Question 9. Do you agree with the proposal to hold the combined award for large lots of geographic interleaved spectrum shortly after the cleared award in 2009? What should the time interval be?

Question 10. Do you agree with our approach to expressions of interest in order to finalise the spectrum lots appropriate to allocate by auction?

Question 11. Do you agree that we should run single unit ascending bid auctions for the award of each of the spectrum lots for Caldbeck, Winter Hill and Wenvoe?

Question 12. Do you have comments on whether the initial auctions of spectrum lots for Caldbeck, Winter Hill and Wenvoe should be run in sequence or in parallel?

Question 13. If the initial auctions are run in sequence do you have a preference for the order in which they run?

Question 14. Do you consider that a combinatorial clock auction would be more suitable than a simultaneous multiple round auction for the combined award of large lots suitable for aggregation?

Question 15. Do you agree with the proposal that the phased award of medium/small spectrum lots at locations linked to the DSO timetable should be by single unit ascending bid auctions? If not, which would be your preferred auction format and timing?

Question 16. Do you agree with the proposals for the main rules that we are minded to adopt for each of the three single unit ascending bid auctions?

Question 17. Do you have any comments on the technical licence conditions we are proposing to include in the licences?

Question 18. Do you agree that the licences for the geographic interleaved spectrum should not allow the co-ordination threshold to be exceeded?

Question 19. Do you agree that where the geographic interleaved spectrum is used for the operation of a DTT multiplex, we should replicate the ownership restrictions from the Broadcasting Act regime relating to (a) local authorities, (b) political bodies, (c) religious bodies and (d) bodies exerting undue influence but not replicate restrictions relating to (e) broadcasting bodies and (f) advertising agencies?

Question 20. Do you agree that we should facilitate interoperability between existing DTT multiplex operators and new operators using cleared spectrum?

Question 21. We welcome views on the merits of the proposed approach to information provision; in particular concerning the type of information that may be helpful and any impacts that publication of information might have both on licence holders and the wider spectrum market.

Question 22. Do you agree with our approach to assessing whether the awards of geographic interleaved spectrum fully promote competition and efficiency?

Question 23. Do you have particular concerns about possibilities for award outcomes to fail to fully promote competition in downstream markets or to result in inefficient use of spectrum? If so, please explain what these are and provide supporting evidence.

Question 24. Do you agree with our proposals to include an information provision licence condition to help facilitate efficient secondary trading?

Question 25. Do you agree with our view that we should not apply any general remedies other than for information provision in the geographic interleaved award?

Question 26. Do you agree with our initial assessment that we should not intervene in the geographic interleaved award to remedy any potential impact on competition resulting from the holding of geographic interleaved spectrum by either Sky or NGW/Arqiva?

Annex 5

Supplementary information on potential interleaved regional DTT coverage

A5.1 In this annex we examine, in more detail than section 5, the optimisation of interleaved spectrum in the nations and the impact on existing DTT services.

Optimisation of interleaved spectrum in the nations

A5.2 The main users of the interleaved spectrum are the existing DTT multiplexes. However there are still gaps, or white space, in the interleaved spectrum which could be used for additional services, as this consultation proposes. So far, all the work to identify potential lots for new services has assumed that the DSO frequency plan for the existing DTT multiplexes is fixed. But it is possible to change the DSO frequency plan (i.e. optimise the interleaved spectrum) to release more white space, whilst still meeting the DSO coverage targets. Ofcom commissioned NGW and Arqiva to look at potential optimisation of interleaved spectrum in Scotland and Northern Ireland respectively.

A5.3 Table A5.1 shows the number of main transmission sites and relay transmission sites, total households and land area for each nation to provide an indication of network scale.

Table A5.1 Statistics for the nations

Nation	Number of main transmission sites	Number of relay transmission sites	Total households	Area in km^2
England	28	642	23.0 million	130,427
NI	3	43	0.7 million	13,843
Scotland	13	226	2.5 million	78,772
Wales	6	200	1.4 million	20,778

Source: Ofcom

Scotland

A5.4 Compared with the rest of the UK, Scotland is more geographically remote from Ireland and Continental Europe. In addition, Scottish transmission sites have little interaction with UK sites in England, Wales and Northern Ireland. Consequently there is more interleaved spectrum available for use in Scotland than anywhere else in the UK.

A5.5 Even more interleaved spectrum could be made available in Scotland with some changes to the DSO frequency plan and international agreement to such changes. This was revealed by work carried out for us by NGW to assess whether the DSO plan in Scotland could be more efficient in its use of spectrum.

A5.6 NGW's study (which we are publishing with this report) indicates that five fewer channels (30, 48, 51, 52, 56) could be used for DSO in Scotland by revising the plan for one main transmission site (Rumster Forest) and nine relays. If these five

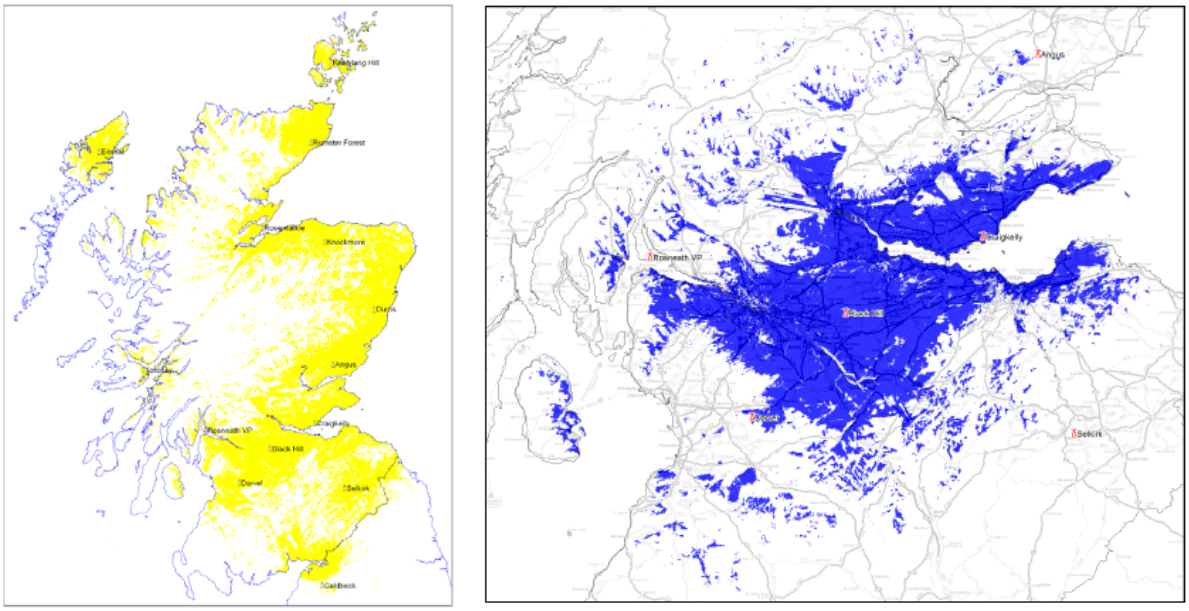
channels were then used for two additional DTT multiplexes, coverage (assuming 64QAM) could be as shown in Table A5.2 and Figure A5.2. Note that these coverage predictions are just examples of what could be done. The five channels offer the potential for many different options, including more robust coverage by existing DTT multiplexes and the use of Single Frequency Networks ('SFNs').

Table A5.2 Potential coverage by additional DTT multiplexes in Scotland

Multiplex	Coverage of Scotland (households)	Notes
First additional	84 per cent	Using network of 15 large transmission sites
Second additional	52 per cent	Using Black Hill and Craigkelly only (i.e. covers Glasgow and Edinburgh)

Source: Ofcom

Figure A5.1 Potential coverage by first (left) and second (right) additional DTT multiplexes in Scotland from optimisation of interleaved spectrum



Source: NGW

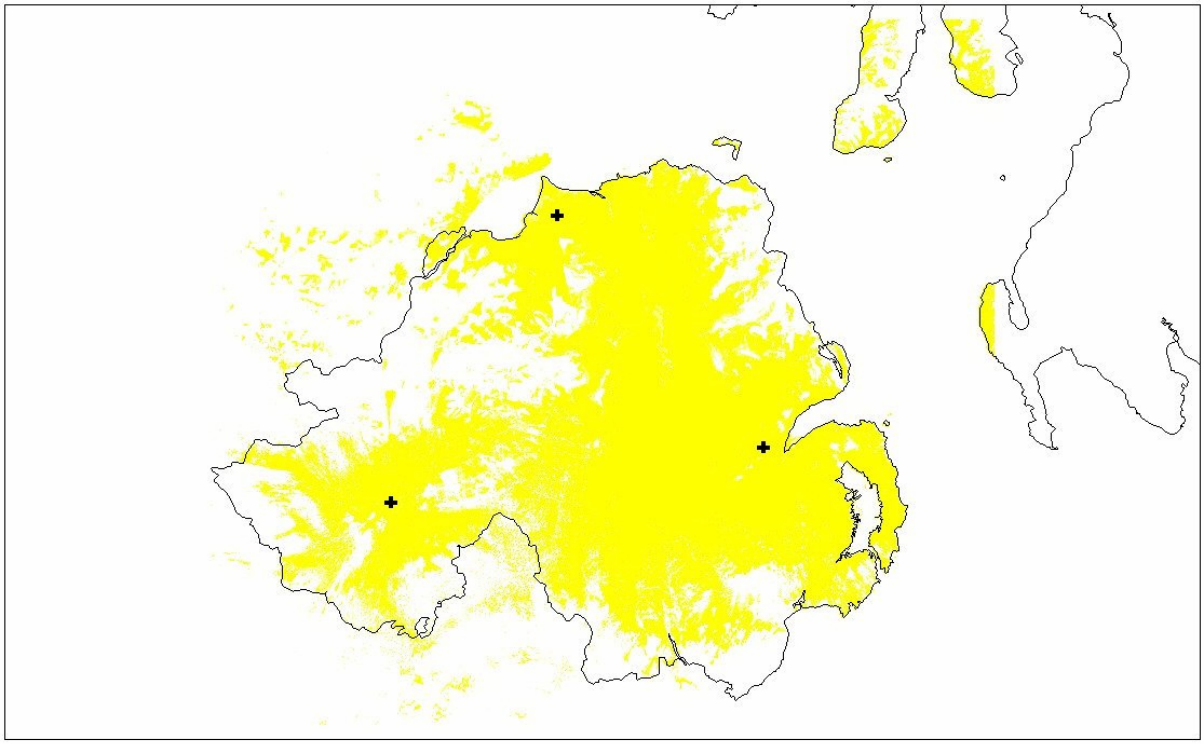
A5.7 We are discussing with the operators of the existing DTT multiplexes the feasibility consequences of making any technical adjustments to the DSO plan.

Northern Ireland

A5.8 A relatively small number of TV transmission sites (3 main transmission sites and 43 relay transmission sites) are used in Northern Ireland. Spectrum use is therefore not too intense. However, there is a large interaction with the Republic of Ireland with overspill coverage from both sides along the land border. There is also some interaction with Scotland. NGW's study shows that 60 per cent of Northern Ireland households could be covered using an aggregated network of four geographic interleaved lots.

A5.9 Arqiva subsequently carried out similar work on DSO spectrum efficiency for Northern Ireland, suggesting improved national coverage of around 85 per cent (see figure A5.2). Again, this would require changes to the DSO frequency plan, and any such changes would need to be agreed by us in consultation with DSO stakeholders and also agreed by our European neighbours where appropriate.

Figure A5.2. Potential coverage from NI main transmission sites from optimisation of interleaved spectrum



Source: Arqiva/Ofcom

Wales

A5.10 Due to its geography and population distribution, it takes almost the same number of transmission sites (and thus frequencies) to cover Wales as it does to cover Scotland, which has four times the land area and twice the population. There is also a widespread interaction with Ireland all along the west coast of Wales, and an interaction with England in the north, east and south of Wales. Thus the spectrum will be very intensively used after DSO in Wales, with relatively little interleaved spectrum remaining.

A5.11 There is little prospect of a significant improvement in available interleaved spectrum capacity being possible in Wales without extensive and complicated changes to the DSO plan. In addition, DSO preparations for Wales are already far advanced (switchover starts in 2009), with DSO transmitter equipment already installed or ordered. Any late amendments to these plans to improve DSO spectrum efficiency are likely to mean additional costs, such as having to replace already installed equipment.

England

A5.12 A similar situation in respect of interleaved spectrum availability exists for England as described for Wales above. There are too many internal and external

interactions for significant additional spectrum efficiency to be realised through changes to the DSO plan. Again, DSO preparations for parts of England are far advanced (Border DSO in 2008/9, Westcountry DSO in 2009, Granada DSO in 2009), and Whitehaven has already switched over.

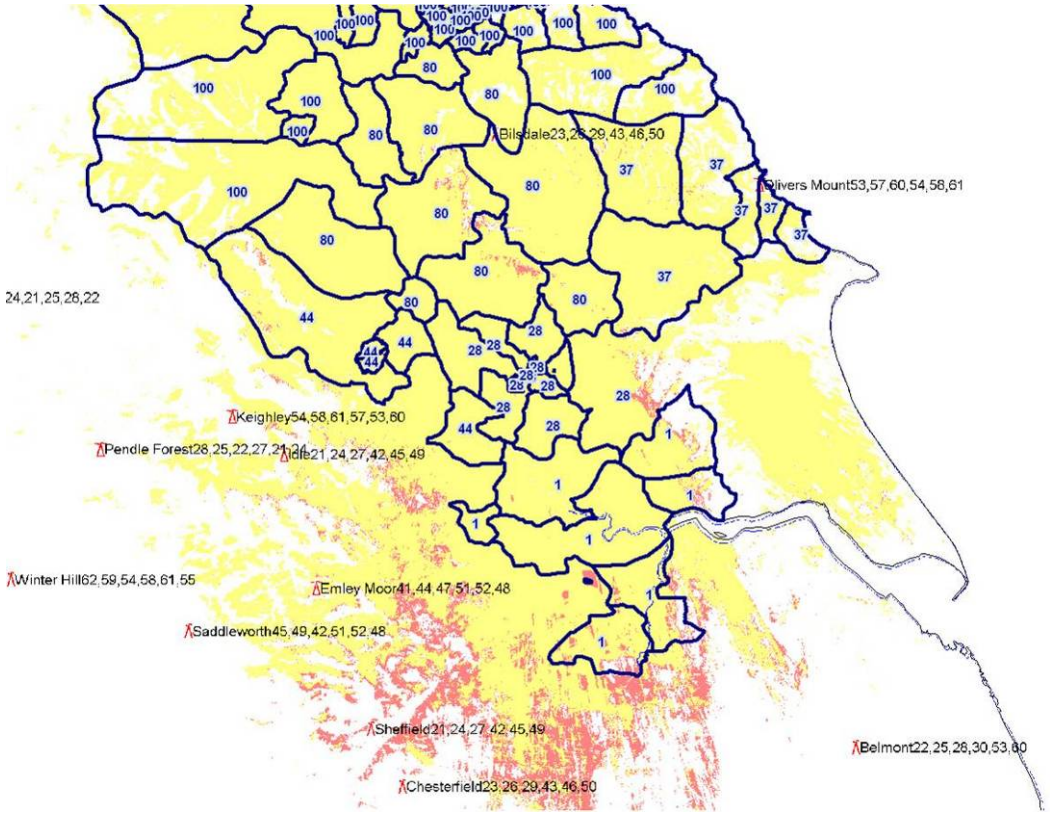
Potential impact of new DTT services on existing DTT services

A5.13 As noted in Section 5, we have considered three options for the protection of existing DTT services – DPSA only, JPP and median. In the following paragraphs we provide a more detailed example of the impact of new DTT services on existing DTT services for each of the three options.

A5.14 To illustrate the practical effect of these three service protection options we have examined in more detail the potential impact of DTT use of a geographic interleaved lot in Sheffield. The new Sheffield DTT service would risk interfering with the existing planned overlapping coverage of Digital 3 and 4's PSB2 multiplex from the Bilsdale transmission site. This example is a worst case example of the maximum potential interference to DTT coverage from the Sheffield lot, using the different protection options, of the 71 main transmission sites we have analysed so far.

A5.15 The results are illustrated below. It can be seen that most of the loss of existing planned Bilsdale PSB2 coverage under the least protective of the three options (DPSA) would be in the Yorkshire region. However in practice few households in Yorkshire would be expected to watch PSB TV transmitted from Bilsdale in this area of Yorkshire, as the Bilsdale transmission site is carrying Tyne Tees regional programmes. Establishment survey data from BARB confirms this. Figure A5.3 shows the postcodes in blue where 1 per cent or more of the households watch Tyne Tees. It can be seen that most of the potential losses in transmissions from Bilsdale (red areas) are well to the south of the transmission site and outside these 'at least 1 per cent Tyne Tees' postcodes.

Figure A5.3 Bilsdale losses and BARB postcodes (per cent households watching Tyne Tees)



Source: NGW/Ofcom

A5.16 So, as shown in table A5.3, for the DPSA-only option, the potential impact of the new Sheffield DTT service on the households which can receive DTT signals transmitted from Bilsdale PSB2 reduces from a theoretical number of around 250,000 households potentially losing the option of watching Tyne Tees (as well as Yorkshire ITV) to around 8,000 if only the losses in the BARB overlap postcodes are taken into account. Furthermore BARB provides an indication of the proportion of households in each overlap postcode actually watching Tyne Tees or Yorkshire e.g. in YO8 (Selby, 20km south of York) postcode, 1 per cent of households watch Tyne Tees; whilst in YO62 (Helmsley, 20km north of York) postcode, it is 80 per cent. If these proportional data are also applied, they further reduce the predicted loss to viewers in Yorkshire of the choice of Tyne Tees PSB signals from Bilsdale to an estimated 335 households.

Table A5.3 Impact of a new Sheffield DTT service on overlaps

DSO Victim	DDR Interferer	Predicted Maximum Gross Loss to Victim (Households)		
		DPSA Only	Median	JPP
Bilsdale PSB2	New Sheffield DTT			
	With Template	250,568	192,384	69,311
	BARB Postcodes	8,073	6,851	352
	BARB Proportional	335	83	4

Source: Ofcom

A5.17 Similar types of effects would be observed for other new interfering transmissions arising from DTT use of geographic interleaved spectrum, although on the basis of our more extensive analysis to date the Bilsdale example above is the largest.

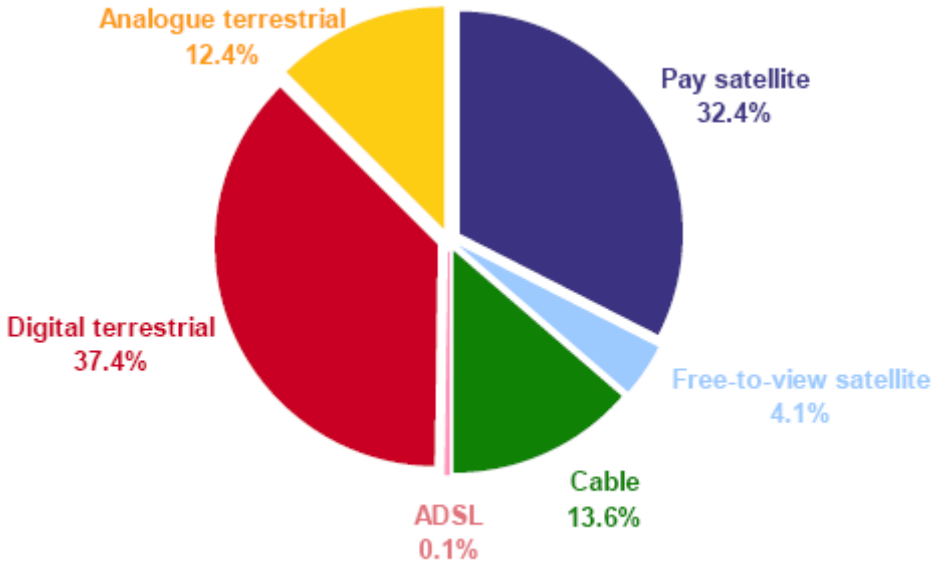
Potential mitigating factors

A5.18 The previous subsection shows the potential mitigating effect of applying the BARB survey data to the predictions of overlap coverage loss for existing DTT services. Other potential mitigating factors are set out in the following paragraphs.

A5.19 DTT services are protected from interference for 99 per cent of the time. Thus if interference occurs for more than 1 per cent of the time in a pixel, the signal is judged to be too poor for that pixel to be counted as covered by the transmissions concerned. However, some households may have higher tolerance thresholds in terms of interference. For example some may not notice, or may be willing to tolerate, interference if it occurs for, say, 2 per cent of the time or some other higher, but still low, percentage. Some of the overlap coverage lost due to new DDT services using geographic interleaved spectrum may only just be exceeding the 1 per cent time interference threshold. In other words all the existing DTT services could still be received after a new service started without any changes to receiving equipment, but the level of interference to one of the signals could be slightly higher than 1 per cent.

A5.20 The latest Ofcom research on the communications market (see http://www.ofcom.org.uk/research/tv/reports/dtv/) includes a breakdown of the means of reception on primary television sets in UK household, as per Figure A6.4. Even assuming all the current analogue terrestrial households switch to DTT after DSO, only about 50 per cent of UK households will be using DTT for their main sets. This is another mitigating factor that could be taken into account when considering the predicted DTT overlap losses. There will be more households using DTT for their secondary sets (up to 76 per cent of all TV sets according to Ofcom research); but as secondary sets are, by definition, generally less used, the likelihood of households noticing interference, even if it occurs for more than 1 per cent of the time, is also less.

Figure A5.4 Platform Share of Main Television Sets, Q4 2007



Source: Platform operators, GfK research, Ofcom estimates.

A5.21 It is important to note that actual affected households should not lose coverage, just the choice of where it comes from, as other transmission sites should still provide an alternative, though realigned and/or replacement aerials could be needed.

Annex 6

Phasing of the award of lots at candidate transmission sites

A6.1 In section 6 we set out here a list of candidate sites and channels for award, based on the set of 71 transmission sites listed in the NGW technical report annexed to our December 2007 Statement, plus 8 transmission sites arising from expressions of interest following the January stakeholder event plus transmission sites for the Crown Dependencies.

A6.2 We also proposed to a series of awards:

- Initial phased award of medium lots in the areas where DSO is before spring 2010 and where there are existing RTSLs (these three sites are Caldbeck, Winter Hill and Wenvoe).
- A combined award of lots most suitable for aggregation in all areas in a simultaneous process.
- Phased awards of medium lots in those areas not already awarded in the initial phase, where these are supported by a suitably developed expression of interest.

A6.3 The table below sets out which sites would be awarded in each phase. We have identified two channels for most of the 25 indicative transmission sites suitable for local television and DTT given in Table 13 of the DDR statement. This has allowed us to include the relevant sites in both the combined awards and the phased awards.

Table A6.1 Phased awards of geographic interleaved spectrum

Site	Indicative lot type	DSO expected by end of	Comments
Initial phased awards – proposed for late 2008 or early 2009			
Caldbeck	Medium	2009	Lots in these awards may be attractive in particular to existing or potential local TV operators interested in broadcasting to a wider footprint or population, e.g. metropolitan areas. Such operators may also be interested in broadcasting to a number of locations or areas and so aggregating a number of geographic lots. In general such services would be provided either on a commercial basis or partially publicly funded in some manner. These sites are used by existing RTSLs and we are committed to including them in this award.
Winter Hill	Medium	2010	
Wenvoe	Medium	2010	
Combined award – proposed for 2009, shortly after the cleared award			
Caldbeck	Medium	2009	Lots in this award may be attractive in particular to broadcasters interested in serving a substantial proportion of the UK. They might wish to aggregate numerous geographic lots in order to form a sub-UK
Winter Hill	Large	2010	
Wenvoe	Large	2010	
Mendip	Large	2010	
Craigkelly	Large	2011	

Site	Indicative lot type	DSO expected by end of	Comments
Black Hill	Large	2011	multiplex. Award of the sites is confirmed unless responses to this consultation demonstrate convincingly that a site should not be included in the award. Sites may be added to this award if we receive sufficiently persuasive expressions of interest.
Oxford	Large	2011	
Waltham	Large	2011	
Belmont	Large	2011	
The Wrekin	Large	2011	
Ridge Hill	Large	2011	
Emley Moor	Large	2011	
Sutton Coldfield	Large	2011	
Sandy Heath	Large	2011	
Sudbury	Large	2011	
Tacolneston	Large	2011	
Hannington	Large	2012	
Rowridge	Large	2012	
Crystal Palace	Large	2012	
Heathfield	Large	2012	
Dover	Large	2012	
Bilsdale	Large	2012	
Pontop Pike	Large	2012	
Londonderry	Medium	2012	
Divis	Large	2012	
Phased awards – proposed for early 2010 and early 2011, in advance of DSO			Lots in these awards may be attractive in particular to existing or potential local TV operators interested in broadcasting to a wider footprint or population, e.g. metropolitan areas. Such operators may also be interested in broadcasting to a number of locations or areas and so aggregating a number of geographic lots. In general such services would be provided either on a commercial basis or partially publicly funded in some manner. These sites will be included in these awards only if a persuasive case is made within the following time limits: for the award proposed for early 2010 – by September 2009; for the award proposed for early 2011 – by September 2010. Sites may be added to the stage three award if a persuasive case is made by the time limits shown above.
Selkirk	Medium	2009	
Beacon Hill	Medium	2009	
Stockland Hill	Medium	2009	
Huntshaw Cross	Medium	2009	
Plympton	Medium	2009	
Redruth	Medium	2009	
Caradon Hill	Medium	2009	
Mendip	Medium	2010	
Preseley	Medium	2010	
Carmel	Medium	2010	
Llanddona	Medium	2010	
Lancaster	Medium	2010	
Saddleworth	Medium	2010	
Storeton	Medium	2010	
Pendle Forest	Medium	2010	
Moel y Parc	Medium	2010	
Kilvey Hill	Medium	2010	
Bristol Ilchester Crescent	Medium	2010	
Bristol Kings Weston	Medium	2010	
Balgownie	Medium	2010	
Rosemarkie	Medium	2010	
Rosneath VP	Medium	2010	
Bressay	Medium	2010	
Keelylang Hill	Medium	2010	
Rumster Forest	Medium	2010	
Eitshal	Medium	2010	

Site	Indicative lot type	DSO expected by end of	Comments
Tay Bridge	Medium	2010	
Perth	Medium	2010	
Knockmore	Medium	2010	
Angus	Medium	2010	
Durris	Medium	2010	
Douglas	Medium	2010	
Craigkelly	Medium	2011	
Black Hill	Medium	2011	
Darvel	Medium	2011	
Luton	Medium	2011	
Oxford	Medium	2011	
Waltham	Medium	2011	
Belmont	Medium	2011	
The Wrekin	Medium	2011	
Ridge Hill	Medium	2011	
Emley Moor	Medium	2011	
Sutton Coldfield	Medium	2011	
Olivers Mount	Medium	2011	
Sheffield	Medium	2011	
Nottingham	Medium	2011	
Kidderminster	Medium	2011	
Lark Stoke	Medium	2011	
Brierley Hill	Medium	2011	
Keighley	Medium	2011	
Malvern	Medium	2011	
Bromsgrove	Medium	2011	
Fenton	Medium	2011	
Sandy Heath	Medium	2011	
Sudbury	Medium	2011	
Tacolneston	Medium	2011	
Poole	Medium	2012	
Guildford	Medium	2012	
Hemel Hempstead	Medium	2012	
Hannington	Medium	2012	
Rowridge	Medium	2012	
Crystal Palace	Medium	2012	
Heathfield	Medium	2012	
Dover	Medium	2012	
Midhurst	Medium	2012	
Salisbury	Medium	2012	
Reigate	Medium	2012	
Whitehawk Hill	Medium	2012	
Tunbridge Wells	Medium	2012	
Bluebell Hill	Medium	2012	
Bilsdale	Medium	2012	
Pontop Pike	Medium	2012	
Londonderry	Medium	2012	
Divis	Medium	2012	
Limavady	Medium	2012	
Brougher Mountain	Medium	2012	

Site	Indicative lot type	DSO expected by end of	Comments
Fenham	Medium	2012	
Jersey and Guernsey	Medium	2013	

Annex 7

Considerations in the choice of auction design

A7.1 In this annex we examine the auction designs that we could use for the series of awards that we proposed in section 6 of this document. The topics we cover are:

- factors that can affect the efficient outcome of an auction; an efficient outcome being one where the winners are those most likely to make optimal use of the spectrum; and
- candidate auction designs for the proposed awards.

Factors that may affect the efficiency of an auction

A7.2 One of our key duties is to secure the optimal use of the radio spectrum. In awarding spectrum licences we consider that auctions offer the best way of ensuring an outcome that will deliver the optimal value for society. Auctions are the most open, transparent and non-discriminatory way of determining who should hold licences. In auctions the bidding process determines which bidders are prepared to pay most for the spectrum. These bidders are likely to be those that place the highest value on the spectrum and will try to make optimal use of it. A well designed auction process should have an efficient outcome, i.e. it should give the maximum flexibility for the market to determine the best use of the spectrum and the identity of the users.

A7.3 In considering what the best auction design would be for the award of the geographic interleaved spectrum we first looked at what could affect the auction's efficiency. The most important factors are:

- *Aggregation risks* – Some bidders may want to offer services in more than one area. The success of their business case could depend on winning spectrum lots in all of the areas of interest to them. If bidders have to bid separately for lots they will face uncertainty about how much to bid, and risk winning unwanted or low value subsets of their full demand. This is what is meant by the 'aggregation risk'. In auction design the best way to meet this risk is to auction the affected lots simultaneously and allow bids for combinations of lots, i.e. package bidding.

  For this award different types of bidder will have different views on the aggregation risk. For local TV bidders there may be no such risk because the business case for running a local TV service in one area could be largely independent of the business case for another area. On the other hand, some bidders may want to aggregate a number of lots to provide a service covering a much wider set of consumers and they could face substantial aggregation risks. If the auction design does not address these risks it may deter them from entering the auction or lead to inefficient bidding behaviour and spectrum allocation outcomes. It will be important for an efficient auction outcome to ensure that potential bidders are not deterred in this way.

- *Substitution risks* – An auction may be for a series of spectrum lots that are very similar, so that bidders may be prepared to obtain any sub-set of them, i.e. the

lots are substitutes for each other. Their preference for one lot rather than another is likely to depend on the relative prices of the lots concerned. If bidders are not allowed to express their preferences they may be forced to buy one lot when, at the prevailing prices, they would have preferred another. This is what is meant by 'substitution risk'. In auction design one way to meet this risk is by selling substitute lots in the same auction and allowing bidders to switch between lots as prices change.

For the award of lots of geographic interleaved spectrum, substitution risks seem to be limited because a licence for one area is unlikely to be a substitute for another area. But it is not entirely absent. Some bidders may be prepared to develop services in one of a number of (potentially overlapping) areas and make their choice on the basis of the relative prices of the spectrum. Also, at some locations we are offering more than one frequency and some bidders may be prepared to obtain any one of them at a particular location, balancing price and potential coverage.

- *Threshold risks* – Package bidding removes aggregation risks but it may then introduce another risk for bidders seeking individual lots or small packages of lots. These bidders may find it difficult to compete against a bidder that is seeking a larger package made up of the lots that they want. The smaller bidders would defeat the larger bidder if the sum of their valuations was higher than his and all bid to their true valuations. The problem is that some of the smaller bidders may keep their bids below their valuation in the hope that others may make sufficiently high bids for the large bidder to be defeated. If enough smaller bidders attempt to free ride in this way it may be that the large bidder will win. This would be undesirable if the more efficient outcome was for the smaller bidders to win. This is what is meant by 'threshold risk'.

  A related issue is the possibility that aggregators may not bid for all the packages for which they have value. This could have the affect that smaller bidders are unable to win specific individual lots, even though they place a higher value on a lot than the incremental value of their rival. In effect, aggregators are overstating their incremental value of a larger package relative to a smaller one by not bidding at all on the smaller one even if it has value to them. This should not happen if aggregators are pursuing a value-based bid strategy and behave rationally as the aggregator would benefit from making a bid for the smaller package. However, if an aggregator deviated from value-based bidding or simply failed to bid on all possible packages that it would be prepared to win, then small bidders might be adversely affected.

  In principle, such risks may be a concern for the simultaneous award of large lots that we propose, given that there are some spectrum lots for relatively small geographic areas. But the fact that there may be substitute lots available in the other auctions should help to mitigate this. It is important that the combination of auction formats selected across all the proposed awards allow a reasonably level playing field between bidders wishing to aggregate lots and those wanting single lots only.

- *Common value uncertainty* and *price discovery* – Where bidders have similar but uncertain business cases it may be useful for them to have information on their competitors' bids. This could allow them to refine their own valuations of the spectrum. Moreover, even if bidders' business cases are very different they may still benefit from price discovery, as information about the underlying value of lots

and level of demand for lots may help to assess aggregation risks and opportunities for selling the spectrum after the auction.

It is difficult to judge how significant common value uncertainty and price discovery might be for different potential bidders in these awards. The test is whether a bidder is likely to revise its own business case and hence bid strategy if it has information about others' valuations. For this spectrum all lots have significant differences and there could be a diversity of business cases.

- *Bidder asymmetries* – In some auctions there may be large differences in the strength of bidders interested in the same spectrum. Some may be well established in a market or have large financial resources. Others may be relatively new to a market or be small companies with few resources. Such asymmetries can have a big impact on participation in an auction and on bidder behaviour. This can undermine the auction's efficiency.

  There are two main problems. First, small or weaker bidders are more vulnerable to overpaying for licences and so may be more cautious in their bidding than large or strong rivals. Second, small bidders may be discouraged from participating if they think they have little chance of outbidding strong rivals. Using sealed bids in a single round process, or restricting the transparency of a multi-round process, may help to reduce the impact of bidder asymmetries, as these approaches make it difficult for large players to assess what bids may be required to defeat smaller rivals.

  Bidder asymmetries could be a concern for this spectrum, for example where local players are competing against strong bidders, such as incumbent media or telecoms providers with established national or regional operations.

- *Complexity for bidders* – It is important that an auction is not unduly complicated for bidders. If bidders do not fully understand the process they may not develop a sound bidding strategy. In that case bidders with the best business case may lose out and the auction outcome will be inefficient. Whatever auction format is chosen it is important to ensure that all potential bidders are given the opportunity to understand the process and key rules fully.

Auction formats we have considered for the proposed awards

A7.4 In this subsection we provide a more detailed description and relative merits of five potential auction formats that we could use for the proposed awards, in the context of their relative ability to address the issues discussed above.

Single unit sealed bid auctions

A7.5 This is a very simple auction format. Bidders are invited to submit a sealed bid for an individual lot during a single round of bidding. A number of lots may be sold at the same time but the sale of each is effectively a separate auction. Bidders decide how much to bid for a lot, and their bid is valid so long their bid is equal to or greater than the reserve price the auctioneer sets. The winning bid for a lot is the highest bid for that lot, with any ties resolved using a random process.

A7.6 Two alternative pricing rules are then possible to determine how much the winning bidder actual pays, either:

- *First price* – the winning bidder pays the amount of their own bid;

- *Second price* - the winning bidder pays the amount of the highest losing bid.

A7.7 Generally, we prefer the second price approach for our spectrum auctions. The first price rule implies strategic complexity for bidders. They must set their bid below their value in order to gain a surplus from winning. The difficulty is in deciding how much to shade down their bids while minimising the risk that their bid will be too low to win. This complexity does not arise with the second price rule. Bidders can simply bid their own value, as they know that if they win they will pay no more than the bid of their strongest rival and will accordingly never risk overpaying for the spectrum. However, in cases where there are substantial bidder asymmetries, the use of a first price may sometimes be preferable if it encourages participation. The uncertainty that the first price rule introduces holds risks for all bidders and this can lead weaker bidders to perceive that they have a reasonable chance of winning relative to larger bidders.

A7.8 There is also the question of how much auction information to reveal to bidders. There are two possible approaches:

- *No transparency* – Bidders submit their applications and bids for lots at the same time. No information about the nature of other participants is provided to bidders until the end of the process.

- *Bidders are pre-announced* – Bidders submit applications in advance of the auction and the identity of all qualified bidders for each lot is announced before the auction starts. If there is more than one bidder for a given lot, the auction proceeds; if there is only one pre-qualified bidder the lot is awarded to that bidder at the reserve price.

A7.9 The simple sealed bid auction format is only appropriate in the case that none of the lots is a close substitute or complement for another and there are no significant synergies between any of the lots. Even in these cases, it may not be appropriate if there are perceived benefits from using an alternative multi-round process to elicit price discovery and ease common value uncertainty.

Single unit ascending bid auctions

A7.10 This is a multi-round alternative to the sealed bid auction of a single spectrum lot. In the first round, bidders are invited to submit bids at a reserve price. If there is more than one bid the auction continues and in subsequent rounds prices are increased. In every round, the bidders can therefore evaluate the increasing price for the spectrum lot and determine whether to stay in the auction or drop out. Bidding continues over a number of rounds until there is only one bidder left. In the event that all remaining bidders stop bidding at the same time, a random process is used to resolve the tie.

A7.11 In this format, the standard approach is for bidders pay the bid amount applicable in the last auction round when there was more than one bid. This is roughly similar to a second price rule in a sealed bid, as the final price is set by the marginal bidder.

A7.12 The same transparency options as described for the sealed bid are available in the period before the auction starts. In addition, there also is a choice as to whether to reveal the number and identity of bidders submitting bids after each round of the auction. Revealing this information may further reduce any common value uncertainty.

A7.13 This format is also only appropriate in the case that none of the lots available are close substitutes or complements for the other. The advantage of this approach over the sealed bid auction is the scope for price discovery and easing common value uncertainty.

Simultaneous multiple-round auctions

A7.14 Like the single unit ascending bid auction, a simultaneous multi-round auction (SMRA) takes place over a number of rounds. However, it entails a number of lots being bid for in each round. Bidders place bids on one or more of the available lots. Prices increase from round to round and in response bidders are able to switch demand between lots, subject to any rules on switching that are established for the auction. The auction closes for all lots at the same time when no new bids are made for any of the lots. Each lot is then assigned to the highest bidder for the lot.

A7.15 SMRAs have been widely used for assigning spectrum licences. The standard SMRA format features a number of distinct spectrum lots. The price of individual lots only rises when they receive a new bid. Thus, over the course of the auction, the relative prices of different lots will vary and bidders can switch between them on the basis of these changing relative prices. The highest bid for some lots may be made before the final round.

A7.16 The SMRA should produce reasonably efficient outcomes where there are a number of substitutable lots and common value uncertainty. Bidders benefit from being able to observe the behaviour of their competitors and alter their demand in response to changes in the relative prices of lots. This mitigates both winners' curse (of under-informed bidders accidentally bidding too much) and substitution risks, and reduces aggregation risks, relative to a sealed bid auction.

A7.17 A simple pay-what-you-bid pricing rule has typically been used in SMRAs. The incentives this rule creates are roughly analogous to the second price rule in a sealed bid or the approach described above for the single unit ascending bid auction. [explain why a different rule gives similar incentives] In all cases, prices are determined by the highest bid of the marginal bidder for each lot.

A7.18 Our preferred approach to transparency would be to reveal the number and identity of applicants before the auction. This makes it easier to ensure that associated bidders do not participate in the auction. During the auction, the revelation of each bidder's activity increases information for other bidders (over and above the knowledge of increasing lot prices that bidders already have) and may therefore further reduce common value uncertainty. But where there are bidder asymmetries, restricting the release of this information may encourage participation by smaller players who are potentially less able to make efficient use of such information.

A7.19 A potential drawback with the simple SMRA format is that it does not fully deal with aggregation risk. Over multiple rounds, bidders can monitor demand and prices, so as to develop an informed judgement of their likelihood of winning complementary lots. However, they still face difficult decisions about the values they place on complementary lots. There is also the risk of being stranded with an unwanted subset of lots if the price of some lots in the full wanted set rises too high for their budget. There are various amendments to the activity rules governing how bidders can bid in each round that can be used try to reduce this aggregation risk. For example bidders may be allowed to withdraw bids to avoid the risk of being stranded with what transpire to be unwanted sub-sets of lots. But such rules make

the auction process more complex, without actually completely eliminating the aggregation risk.

A7.20 Selling licences in a simultaneous process also introduces scope for strategic behaviour by bidders. For example, as bidders can switch demand across different lots, it is possible to hide true demand for one lot by bidding on an alternative lot and then switching later in the auction. The scope for such behaviour may be increased by rules, such as relaxed activity requirements, that are designed to ease aggregation risks. Depending on the nature of strategic bidding, this may compromise the efficiency of the auction outcome.

Sealed bid auctions with package bidding

A7.21 Package bidding in combinatorial auctions is used for assigning multiple lots where bidders have synergies between them. Bidders can submit separate bids for each specified combination of lots they would like to acquire. They can submit bids for individual lots or for packages of lots, and place different amounts on each lot and package. The winning bidders are determined by calculating the combination of bids that generates the highest revenue.

A7.22 Package bidding can be implemented in either a single-round sealed bid or a multiple round auction. In the single round sealed bid format, bidders have a single bid window in which to submit package bids for every combination of lots (packages) that they are willing to buy.

A7.23 As with the simple sealed bid, there are two possible pricing rules:

- first price rule – winning bidders pay the amount of their winning bids; or
- second price rule – winning bidders pay prices set at the minimum level where losing bidders (or groups of losing bidders) would not wish to purchase spectrum instead of the winners.

A7.24 We generally prefer to use a second price rule, to make it simpler for bidders when deciding what to bid. The second price rule is more complex for the auctioneer to implement in combinatorial auctions than in single unit auctions, although bidders are not exposed to the complexity concerned. It is based on the principle that a winning bidder should pay the least amount consistent with them winning the spectrum while there is no bidder or group of bidders prepared to pay more. An algorithm must be used to calculate the final price which achieves this requirement. This approach mimics the outcome of an open competitive process and provides good incentives for bidders to bid at or close to their true value.

A7.25 The transparency choices are essentially the same as for the single unit sealed bid.

A7.26 The main benefit of package bidding is that it allows bidders to eliminate aggregation risks, as they can bid up to their full value for any selected package of lots, without risk of being stranded with unwanted subsets of their total demand. Typically, this may create a more level playing field between bidders trying to aggregate lots and those not trying to aggregate (or aggregate to a lesser extent), thus facilitating more efficient auction outcomes.

A7.27 Under certain circumstances package bidding in a single round environment may create threshold risks for small bidders.

A7.28 Threshold risks are primarily a problem when a first price rule is used. If a second price approach is used, strategies of bidding below true value are unlikely to change the distribution of payments across the winning bidders while always leading to risks of not winning.

A7.29 A further issue with package bidding is its potential complexity for bidders, as all the various permutations of packages have to be examined and bid for. If there are many lots, there will be very large numbers of package options for bidders to consider. However, single round package bidding would imply that bidders should have plenty of time in advance to consider their bids. The requirement for an algorithm to determine the winners and solve prices also means that the outcome is not as easy to check as with more basic formats. But this is mainly a problem for the auctioneer and should not affect bidding behaviour.

A7.30 Finally, as with the single unit sealed bid, the sealed bid package bid auction does not provide any scope for price discovery and reducing common value uncertainty.

Combinatorial clock auction

A7.31 In a simple clock auction bidding for a number of similar lots takes place in a series of rounds. The auctioneer announces the price per lot at the beginning of each round and bidders say how many lots they would like to buy at that price. Bidding continues until the aggregate number of lots bidders are willing to buy at the current price is no more than the number available. Each bidder remaining in the auction at the end wins the number of lots it bid for in the final round and pays the price set for the final round.

A7.32 The combinatorial clock auction (CCA) is a development of this format. It allows package bidding over a number of rounds. This both eliminates aggregation risks and alleviates common value uncertainty. The CCA consists of two phases of bidding: the primary bid rounds; and a supplementary bids round:

- *Primary bid rounds* – The primary bid rounds follow a clock auction format. Bidders make a single bid in each round for a package of one or more lots. Where there is excess demand for at least one of the lots, prices for the affected lots are increased in the next primary bid round, and the rounds continue until there is no excess demand for any lots.

- *Supplementary bids round* – The supplementary bids round is in the form of a single round sealed bid auction with package bidding. Bidders have the opportunity to make multiple bids for alternative packages of lots, subject to constraints created by their primary round bids.

A7.33 We propose to use this format in the award of the DDR cleared spectrum, for the reasons set out in our parallel consultation on the cleared award auction. We have already used this format for the UK 10 GHz to 40GHz auction in February 2008 and the L Band award in May 2008. We have also decided to use it in the 2.6 GHz award.

A7.34 Following the conclusion of the supplementary bids round, the auctioneer identifies the highest value combination of bids that can be accommodated, drawing on all valid bids from the primary and supplementary bids rounds and taking at most one bid from each bidder. This process is the same for the sealed bid package auction format described above (except for the inclusion of bids from earlier rounds and associated constraints on supplementary bids).

A7.35 To date in all proposed implementations of the CCA format, we have proposed using a ‘second price’ rule to determine the price for each winning bid for a package of lots. It is unlikely that we would take a different approach if we used a CCA for the award of geographic interleaved spectrum, given the strong benefits of a second price approach, as described above for the sealed bid package bid format.

A7.36 With respect to transparency before the auction, our preferred approach has been the same as for a standard SMRA, i.e. to reveal the number and identity of applicants. This makes it easier to ensure that associated bidders do not participate in the auction. As with the standard SMRA however, the case for transparency during the CCA is less certain. Transparency about which bidder is bidding for which lot increases information for other bidders and may therefore further reduce common value uncertainty. However, in an open process it may also facilitate tacitly collusive outcomes and allow leverage strategies to be deployed more effectively, i.e. the limitation of package bids to reduce the chances of other bidders winning. In many cases, most of the common value uncertainty can be addressed by simply by revealing aggregate information (e.g. total number of bids for each lot) round-by-round. This significantly limits the ability of individual bidders to engage in strategic behaviour such as leverage or tacit collusion.

A7.37 The advantages of this format with respect to aggregation and substitution risks are similar to those discussed for the single round sealed bid package bid auction. The main advantage of this approach relative to the sealed bid version is the scope for price discovery and hence alleviating common value uncertainty. Against this, one must consider the possibility that threshold risks are aggravated in the context of an open auction, because bidders can potentially send signals to each other through their bids, and have more information on which to judge whether strategic behaviour may be effective. Such concerns may, however, be substantially mitigated through restrictions on transparency.

Annex 8

Description of combinatorial clock auction design

Introduction

A8.1 The combinatorial clock auction (CCA) allows bidding for packages of lots over a number of rounds. It consists of two bidding stages: the primary bid rounds; and a supplementary bids round:

- *Primary bid rounds* – The primary bid rounds follow a clock auction format. The auctioneer announces the price per lot at the beginning of each round and bidders say how many lots they would like to buy at that price. Bidders make a single bid in each round for a package of one or more lots. Where there is excess demand for at least one of the lots, prices for the affected lots are increased in the next primary bid round, and the rounds continue until there is no excess demand for any lots.

- *Supplementary bids round* – The supplementary bids round is in the form of a single round sealed bid auction with package bidding. Bidders have the opportunity to make multiple bids for alternative packages of lots, subject to constraints created by their primary round bids.

A8.2 Following the conclusion of the supplementary bids round, the auctioneer identifies the highest value combination of bids that can be accommodated, drawing on all valid bids from the primary and supplementary bids rounds and taking at most one bid from each bidder. The bids making up the highest value combination are the winning bids.

Activity rules and bid submission in the primary bid rounds

A8.3 In each round of the primary bid rounds, bidders may submit a single bid for a package of lots, based on the current clock prices.

A8.4 The minimum participation requirement in the auction is that a bidder must submit a valid primary bid in the first primary bid round. If a bidder fails to meet this requirement it will be excluded from the award process and forfeit its deposit.

A8.5 There is an activity rule which applies throughout the primary bid rounds. In each round, the sum of eligibility points associated with the component lots in a bidder's bid cannot exceed their current eligibility limit. In the first round, a bidder's initial eligibility limit is determined by the level of its deposit. In subsequent rounds, eligibility is determined by the level of a bidder's activity in the previous round. This activity is measured by the total number of eligibility points associated with the component lots in its bid. For example, if a primary bid has 15 eligibility points attributable to it the bidder's eligibility limit for the next primary bid round is 15; and that bidder cannot make a primary bid in any subsequent primary bid round for a selection of lots that has more than 15 eligibility points attributable to it.[50]

[50] In effect this is a 100 per cent activity requirement and differs from the activity rule normally used in SMRAs, where the auctioneer may set an activity requirement between 0 per cent and 100 per cent

A8.6 If a bidder does not submit a valid primary bid in a primary bid round its eligibility limit in subsequent primary bid rounds will be zero.

A8.7 The activity rule ensures that aggregate demand in the auction – as measured by the sum of eligibility points associated with all bids made in a single round – cannot increase.

Clock prices and bid increments

A8.8 There is a separate price clock for each lot. The clock prices in the first round are set equal to the reserve prices.51

A8.9 In subsequent rounds, clock prices of lots in excess demand are increased, being set equal to the price for that lot in the previous round plus a bid increment. Prices of lots for which there is no excess demand are unchanged from the previous round.

A8.10 Different bid increments may be used for different lots, and the size of the bid increment may vary from round to round, at the discretion of the auctioneer. In setting the appropriate bid increment, the auctioneer will take into account factors such as the level of excess demand for a lot category; relative prices across lots, the ability of bidders to express preferences for different numbers of lots at different price points and the pace of the auction.

Managing the pace of the auction

A8.11 Rules concerning bid increments and the timing of rounds will affect the pace and management of the auction process. The auctioneer needs flexibility in managing the pace of the auction such that it can proceed as quickly as possible, without jeopardising efficiency.

A8.12 Rounds need only be as long as is necessary to allow bidders to input, check and submit their bids. As with bid increments, the auctioneer needs flexibility to determine the length of a round. Early in the auction, when bidders are getting used to the system, round lengths of, say, 30 minutes or more may be required. However, later in the auction, when there may be very few new bids or price changes involved in each round, shorter rounds of about 15 minutes or less may be feasible.

A8.13 Intervals between rounds are important in managing the pace of the auction. The auctioneer will have the flexibility to set the timetable for rounds on a day-by-day basis. The interval between rounds will need to be long enough for bidders to digest the result of the latest round and to decide how to bid in the next round. 30 minutes notice of the start of a round should be sufficient. As the auction progresses it may be possible to decrease the interval between rounds and so increase the number of rounds per day.

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for each stage of the auction. The flexibility for SMRA bidders that the variable activity level allows is not so important for package bidding, particularly with a supplementary bids round.

[51] This is different from our proposal for the single unit ascending bid auctions. For that design the first round price would be the reserve price plus an increment. This is related to the rule under which a bidder may make a discretionary bid where it wants to pay less than the round price the auctioneer has set. The discretionary bid must be higher than the previous round price. In the first round this means it must be higher than the reserve price, and it follows that the round price must also be higher than the reserve price. In the CCA we are not proposing to include such a rule as we consider it would overcomplicate the auction.

End of the primary bid rounds

A8.14 At the end of each primary bid round the auctioneer determines whether there is excess demand for any lot given the most preferred packages stated by bidders. If there is excess demand on any of the lots there will be another primary bid round. If, at the end of a primary bid round, there is no lot in respect of which there is more than one bid there will be no more primary bid rounds.

A8.15 The auctioneer may determine that there shall be no further primary bid rounds even if, at the conclusion of a round, there is one or more lots in respect of which there is more than one bid. It may do this where it is satisfied that it is unlikely that the information that would be available to bidders if there were further primary bid rounds would affect the outcome of the auction.

Supplementary bids round

A8.16 All bidders that submitted a valid primary bid in the first primary bid round will be entitled to participate in the supplementary bids round, provided they have not subsequently been excluded from the award process. Bidders are under no obligation to make use of supplementary bids. However, in the event that there are otherwise unallocated lots at the end of the primary bid rounds, they can improve their chances of winning additional lots through making supplementary bids.

A8.17 The supplementary bids round gives bidders the opportunity to raise their primary round bids and to bid for packages of lots that they did not bid for in primary bid rounds. All valid bids received from bidders in both the primary bid rounds and the supplementary bids round are considered in determining the winning bidders.

A8.18 The supplementary bids round is in the form of a single round sealed bid auction with package bidding. Using sealed bids in a single round process may help to reduce the impact of bidder asymmetries, as these approaches make it difficult for large players to assess what bids may be required to defeat smaller rivals.

A8.19 The supplementary bid round will be completed within one day.

Winner determination

A8.20 Winning bids are determined by taking into account all primary round bids and all supplementary bids. The winning bids are the set of bids of greatest total value, subject to:

- no more lots being awarded than are available;
- at most one bid being accepted from each bidder.

A8.21 In the event that there is more that one set of bids of exactly the same greatest total value, the set of bids that has the highest number of eligibility points associated with it will be the winning set of bids. If there is more than one set of such bids a random process shall be used to determine which set of bids is successful.

A8.22 Including in the winner determination all bids made during the auction not only promotes an efficient outcome but should also encourage realistic bidding, as there is always a possibility that any bid submitted could be a winning bid. Further, because all package bids submitted by the same bidder are mutually exclusive, and

are accepted or rejected in their entirety, bidders are not exposed to aggregation risks.

Determination of prices to be paid

A8.23 In the CCAs that we have run to date we have use a second price rule to determine the prices paid by winning bidders. These are prices paid for packages of lots by winning bidders such that:

- there is no dissatisfied bidder or grouping of bidders able to suggest an alternative outcome (in terms of prices paid and lots received by the bidder or group) preferred by all group members and which achieves greater total revenue; and
- these are the lowest such prices, so there are not alternative prices satisfying the first condition which all bidders prefer.

A8.24 This corresponds to a notion of competitive pricing, in that winners have paid sufficient such that losers cannot suggest an alternative that does not make the seller worse off. Winners need to pay the minimum amount sufficient for there to be no other bidder or group of bidders willing to make a counter-offer for some or all lots that the seller would prefer.

A8.25 Typically, there are many possible prices satisfying these conditions. Among all these possible prices those closest to the opportunity cost of each bid would be selected.

A8.26 The advantage of this pricing rule over a simpler ‘pay what you bid’ rule is that it substantially reduces the incentives for the remaining bidders at the end of the primary bid rounds to shade their supplementary bids, submitting bids significantly below their valuations. The amount that winning bidders will ultimately pay is determined primarily by the bids of competitors, so there are good incentives to make bids close to the value that bidders place on packages.

Transparency

A8.27 At the end of each primary bid round the auctioneer will announce the level of excess demand for each lot. There are a number of further options for releasing additional information:

- releasing all primary bids on an anonymous basis (i.e. the packages bid on but not who made them); and
- full transparency of all bids made in the primary bid rounds (including the identity of the bidder).

A8.28 Releasing the details of all primary bids on an anonymous basis would help reduce common value uncertainty. The pros and cons of additionally having full transparency are difficult to judge. Full transparency would provide somewhat richer information for bidders to benchmark their valuations against the behaviour of other bidders, and so further reduce common value uncertainty. However, much of this benefit would already have been obtained by releasing these bids on an anonymous basis. Against this, full transparency might facilitate collusive behaviour.

Electronic bidding

A8.29 A CCA of the above form, to be managed efficiently, will be run electronically allowing remote bidding over the internet.

Annex 9

Description of simultaneous multiple round auction design

A9.1 A simultaneous multiple round auction (SMRA) is an auction for a number of lots in which bidding takes place over a series of rounds. In each round bidders simultaneously make bids for any lots that they want to obtain. The number of lots on which a bidder may bid in a round is limited by the auction activity rules, which are explained below. Bidders may switch between lots: a bidder who has bid on a lot in a previous round but does not currently hold the highest current bid on that lot is not obliged to continue bidding on it.

Bid prices

A9.2 In each round, the auctioneer notifies bidders of an 'asking price' for each lot. The asking price of each lot in the first round is the reserve price[52]. Bidders signify their willingness or otherwise to bid for the lot at the asking price. Bidding on all lots takes place simultaneously. Providing at least one bidder bids at the asking price, the asking price becomes the 'standing high bid' for that lot. If only one bidder bids for a particular lot at the standing high bid it becomes the standing high bidder for that lot. If more than one bidder bids for a particular lot the standing high bidder for that lot will be chosen by a random method. A standing high bidder may not bid in the following round in respect of any lot for which it is the standing high bidder.

A9.3 Following the determination of the standing high bidder, the auctioneer specifies a new asking price for a lot. Unless another bidder subsequently raises the bid to the new asking price for that lot the standing high bidder will, at the end of the auction, be awarded that lot at the standing high bid.

A9.4 There is an alternative bidding and pricing rule that allows bidders in each round to set the price they are prepared to pay for a lot. The price must be above the standing high bid and within a maximum that the auctioneer sets. The bidder making the highest bid becomes the standing high bidder. The auctioneer will set prices from round to round by increasing the standing high bid. In the event that there is a tie for the standing high bid, the auctioneer may use a random method to determine which of the tied bidders will be deemed to be the standing high bidder. The other bidder(s) will always be able to bid more in the next round and will not be arbitrarily excluded from further action in the auction.

A9.5 The auction continues until all the bidders who are not currently holding the highest bid for a lot have withdrawn. Each lot is then awarded to the highest bidder at the final standing high bid.

[52] This is different from our proposal for the single unit ascending bid auctions. For that design the first round price would be the reserve price plus an increment. This is related to the rule under which a bidder may make a discretionary bid where it wants to pay less than the round price the auctioneer has set. The discretionary bid must be higher than the previous round price. In the first round this means it must be higher than the reserve price, and it follows that the round price must also be higher than the reserve price. In the SMRA we are not proposing to include such a rule as we consider it would overcomplicate the auction.

Activity rules and bidder eligibility

A9.6 The eligibility points that a bidder holds determines the maximum number of lots that it may bid for in the auction. Unless there are significant differences between lots, in terms of spectrum characteristics or coverage, each lot is assigned one eligibility point.

A9.7 Applicants are required to state how many lots they wish to bid for and this will determine their eligibility points at the start of the auction. Applicants do not have to declare in advance which lots they wish to bid for, as the activity rules allow switching bids between lots as relative prices change.

A9.8 Activity rules are designed to ensure each bidder participates fully in the auction. Bidders should not be able to refrain from bidding until a late stage in the auction, having watched bidding activity in the early rounds. Such bidder behaviour would enable it to assess others' actions without revealing its own strategy. This is counter to a key function of the SMRA, which is the sharing of information between bidders, and all must engage fully to allow this.

A9.9 A bidder is active in a round if it either

- holds the highest bid on one of the lots, *or*
- makes an acceptable bid on one of the lots, *or*
- exercises a waiver. A bidder who would otherwise be required to bid or withdraw from the auction may also exercise one of a limited number of waivers that allows him to take no action in that round without being deemed to have withdrawn from the auction. (See paragraph A9.23 below for discussion of the desirability of waivers.)

A9.10 In order to ensure full participation each bidder will have to meet the activity levels set by the auctioneer, or else lose eligibility points. The auctioneer may decide to set an activity requirement of 100 per cent throughout the auction. Alternatively, it may decide to use activity requirements that become progressively more onerous as prices come closer to final prices. Setting activity requirements in stages in this way is the approach used in many previous SMRAs.

A9.11 The advantage of using stages is that it allows more fluid switching between lots, as bidders do not necessarily need to bid on all of the lots that they might ultimately need until late in the auction when prices are more informative. With this approach, the auctioneer would set an activity requirement between 0 per cent and 100 per cent for each stage of the auction.

A9.12 To illustrate how the activity rule works in general, suppose that eligibility at the start of a round was E. A bidder would need to have activity of at least X*E[53] – this is the Activity Requirement (AR). If the level of activity (A) is less than the activity requirement (AR), eligibility in the next round is reduced in proportion to the shortfall, i.e. eligibility becomes E*A/AR (again rounding to an integer may be required).

A9.13 Here are some examples to illustrate the procedure:

[53] Rounding is required if X*E is not an integer.

- A bidder has seven eligibility points. The activity level factor is 50 per cent. The activity requirement needed to maintain his eligibility points in the next round is therefore four (i.e. 7 x 50 per cent=3.5, rounded up).

- A bidder has eight eligibility points. The activity level factor is 80 per cent. The activity requirement needed to maintain his eligibility points in the next round is therefore seven (8 x 80 per cent=6.4, rounded up). He bids on six lots in the current round. His eligibility points are reduced to seven (6/0.8 = 7.5) for the succeeding round.

- A bidder has eight eligibility points. The activity level factor is 50 per cent. He is the standing high bidder on one lot and bids on two lots in the current round. His eligibility points are reduced to six (3/0.5 = 6) for the succeeding round.

- A bidder has three eligibility points. The activity level factor is 100 per cent. He bids on two lots in the current round and is standing high bidder on no lots. His eligibility points are reduced to two for the succeeding round.

- A bidder has eight eligibility points. The activity level factor is 50 per cent. He is standing high bidder on no lots. He validly exercises a waiver and bids on no lots in the current round. His eligibility points are maintained at eight for the succeeding round.

Deposit and payment rules

A9.14 Deposits are upfront payments that will be forfeited if a bidder breaks auction rules or a winning bidder defaults on its payment. They help to deter frivolous bidders and to reduce any strategic incentives for default. The initial deposit could be either a flat rate or linked to the number of lots an applicant wishes to bid for. In an SMRA the latter approach is normally used. This ensures that the gains from default (to potential defaulters) are diminished and links deposits to bidder demands.

A9.15 Setting bid deposits is less straightforward. Given the possibility that bids in the auction could rise to many times the minimum bid prices, the initial deposits could during the course of the auction become too small a proportion of bids to act as an adequate deterrent to default. The auctioneer will employ a mechanism to ensure that bidders increase their deposits in a way that reflects their aggregate bid levels at various points during the auction.

A9.16 Winning bidders will be required to pay, by a specified time, 100 per cent of the fee for lot(s) they have won, and licences will only be issued after payment has been received. Further, if a bidder defaults on payment it will forfeit its deposit and will remain liable for the outstanding balance and it will not be granted a licence.

Bid withdrawal

A9.17 Bid withdrawal is a means of reducing aggregation and substitution risks by allowing current high bidders to withdraw their bids. Where there are aggregation risks, such that a bidder risks being stranded on a lot for which it has little value when not combined with another complementary lot, there may be an argument to allow bid withdrawal. In addition bidders may face substitution risk, where they are the highest bidder for a lot for which there is a lower priced substitute.

A9.18 Withdrawals allow bidders some flexibility but carry a potential penalty. The bidder making the withdrawal will be liable to pay a penalty if there is no subsequent bid on

the lot at or above the withdrawn bid. This penalty might be equal to the difference between the withdrawn bid and the highest admissible bid received on the lot subsequent to the withdrawal (or the reserve price, if there is no subsequent bid).

Managing the pace of the auction

A9.19 Rules concerning bid increments and the timing of rounds will affect the pace and management of the auction process. The auctioneer needs flexibility in managing the pace of the auction such that it can proceed as quickly as possible, without jeopardising efficiency.

A9.20 Bid increments are set by the auctioneer to control the pace of the auction. Large bid increments can be used to accelerate the pace of the auction, but they should not be so large that they lead to an inefficient assignment at the margins. The auctioneer's flexibility to set increments up to 100 per cent should allow him to effectively steer the pace of the auction and react to the level of activity.

A9.21 Rounds need only be as long as is necessary to allow bidders to input, check and submit their bids. As with bid increments, the auctioneer needs flexibility to determine the length of a round. Early in the auction, when bidders are getting used to the system and may have many new bids to submit each round, round lengths of, say, 30 minutes or more may be required. However, later in the auction, when there may be very few new bids or price changes in each round, shorter rounds of about 15 minutes or less may be feasible.

A9.22 Intervals between rounds are important in managing the pace of the auction. The auctioneer will have the flexibility to set the timetable for rounds on a day-by-day basis. The interval between rounds will need to be long enough for bidders to digest the result of the latest round and to decide how to bid in the next round. 30 minutes notice of the start of a round should be sufficient and as activity in the auction slows it should be possible to decrease the interval between rounds and so increase the number of rounds per day.

Waivers

A9.23 Waivers allow a bidder to refrain from bidding in a round without sacrificing eligibility in the next round. It may want to do this because it is unable for technical reasons to submit a bid or wishes to stand back from the auction and assess the position. These are acceptable reasons but bidders may also use waivers to disrupt the flow of the auction and unnecessarily prolong it. Where a bidder is unable to submit a bid within the round time an alternative to exercising a waiver is for the auctioneer to allow the bidder a round extension. We prefer this option, which avoids the possible disruptive use of waivers.

Transparency

A9.24 Bidders need information on others' bids to help their decision making in the auction. The downside of releasing information on bids is that it can assist collusion between bidders or give strong bidders the opportunity to indulge in aggressive tactics designed to discourage weaker bidders.

A9.25 In order to bid sensibly bidders need some information on activity during each round. There are a range of options for releasing information to bidders in an SMRA, including for example, releasing the number of bidders active in a round or comprehensive information about the number and amount of bids on each lot.

Bidders could also be given information to enable them to monitor the identity of all other bidders and the bids they made. In addition, bidders could receive information about each bidder's initial eligibility and changes in eligibility on a round by-round basis.

Electronic bidding

A9.26 An SMRA, to be managed efficiently, will be run electronically allowing remote bidding over the internet.

Annex 10

Examples of bidding document

Example bid form: Amy in round 2

Ofcom
OFFICE OF COMMUNICATIONS

Auction of Wenvoe licence

Channel 51 (710MHz-718MHz)

Round 2 in progress

Round 2 will close today at 16.30

Enter your bid on the form below and click on the **Check bid** button at the bottom of the page to check the validity of your bid. You will then be presented with a summary, and if your bid is valid, given the option to submit your bid by clicking on the **Submit bid** button. You have not submitted a bid until you have clicked on the Submit bid button and received an acknowledgement from the system.

Your previous bid amount: **£ 35,000**

New bid amount: **£ 49,000**

Please enter your bid decision:

- (●) **Accept the new bid amount**
- ( ) **Reject the new bid amount**

If you reject this bid amount, you may enter a maximum bid, which must be greater than £35,000 and less than £49,000

Your maximum bid amount: **£**

Check bid

Example bid form: Ben in round 4

Ofcom
OFFICE OF COMMUNICATIONS

Auction of Wenvoe licence

Channel 51 (710MHz-718MHz)

Round 4

Round 4 will close today at 16.30

Enter your bid on the form below and click on the **Check bid** button at the bottom of the page to check the validity of your bid. You will then be presented with a summary, and if your bid is valid, given the option to submit your bid by clicking on the **Submit bid** button. You have not submitted a bid until you have clicked on the Submit bid button and received an acknowledgement from the system.

Your previous bid amount: **£ 59,000**

New bid amount: **£ 71,000**

Please enter your bid decision:

○ **Accept the new bid amount**

● **Reject the new bid amount**

If you reject this bid amount, you may enter a maximum bid, which must be greater than £59,000 and less than £71,000

Your maximum bid amount: **£ 69,002**

Confirm bid

Annex 11

Protection clause

Introduction

A11.1 This Annex sets out the matters we considered in relation to the protection clause for the geographic interleaved spectrum awards. We have proposed that such a 'protection clause' is included in the licences to be awarded for the cleared spectrum[54]. However, the lots of geographic interleaved spectrum that we are proposing to award for new DTT services will be tightly defined using the UKPM and a fixed set of interference entries into existing DTT services. In this case no additional protection is required into the existing DTT multiplexes and we do not, therefore, propose to include a protection clause in the licences for this award, as set out in section 8.

A11.2 For new services other than DTT in the geographic interleaved spectrum, there may be less certainty as to the interference entry into existing DTT services. In this case an additional protection clause will be included to ensure that existing DTT are protected

Protection of the existing DTT multiplexes

A11.3 The existing DTT multiplexes are broadcast from a fixed network of transmission sites across the UK. Three of these multiplexes (the public service multiplexes) carry public service content (such as BBC and ITV services) and will be broadcast from 80 medium to high power transmission sites and over 1,000 low-to-medium power relay transmission sites. The public service multiplexes are required by their licences (and in the case of the BBC its Royal Charter) to match the coverage of the existing analogue terrestrial network.

A11.4 Our research has concluded that analogue services are available to 98.5 per cent of UK households for roof-top reception. The UK's digital switchover plan (as prepared by the JPP) has therefore allocated suitable frequency assignments (based upon the outcome of the GE-06 conference) to the public service multiplexes that, it is predicted, would enable them to match this coverage post-switchover.

A11.5 The three remaining multiplexes are operated on a commercial basis and do not have any specific coverage obligations in their licences beyond the requirement not to reduce their existing coverage at switchover. The UK Planning Model (UKPM) predicts that the existing multiplexes currently cover around 73 per cent of UK households from 80 transmission sites.

A11.6 The commercial multiplex operators have indicated to us that they do not intend to adopt additional sites at switchover but that they will adopt the maximum power possible at these sites at switchover. The JPP has optimised the UK switchover plan to implement this and it is currently expected that they will collectively cover just over 90 per cent of UK households following switchover.

A11.7 It is possible that any new services that are deployed in the any DDR spectrum close to the channels used for these post-DSO DTT transmissions could interfere

[54] See section 5 of the Cleared consultation, http://www.ofcom.org.uk/consult/condocs/clearedaward/condoc.pdf

with their reception. In some cases, this interference may be sufficient to prevent the reception of DTT signals in areas where they are planned to occur.

A11.8 Given the coverage obligations imposed on the PSB DTT providers and our desire to maximise commercial multiplex coverage across the UK, together with their need to operate from fixed sites and tightly defined transmission parameters, it is appropriate to consider a high level of protection for existing PSB and commercial DTT services. Hence, taking this into account and our duties to secure optimal use of the radio spectrum, we might expect to employ more stringent or additional protection measures than would normally be the case.

A11.9 We considered a protection clause which places an obligation on the licensee, in the first instance, to avoid interference in light of the post-DSO DTT coverage plan but if interference is caused, to remedy any case where DTT reception is disrupted. This appears to us as being an effective way of balancing our duties for the following reasons.

- For the broadcasters it offers protection of DTT reception from all neighbouring licensees. If interference is caused, it places the obligation to remedy the interference, in an appropriate and flexible manner, on those creating the interference.

- For those deploying new services in the interleaved spectrum it enables them to deploy networks efficiently and to utilise the radio spectrum close to DTT, in frequency and geographic terms. As the DTT network and the coverage it provides are defined and the transmission sites are fixed, it is possible to provide a clearly defined plan against which interference can be controlled. This offers new service providers certainty in knowing what they must protect. This gives them the ability to roll out networks and avoid causing interference. If interference is caused to DTT reception they have the choice of adjusting their transmissions to restore the situation (for example by reducing the power of transmissions or by moving the equipment elsewhere) or of remedying the reception of those affected (for example by installing superior reception filters to those affected).

- For new DTT services in the geographic interleaved spectrum, the UKPM intrinsically provides protection for existing DTT services from new DTT services transmitting from existing DTT sites. Therefore, where the geographic interleaved spectrum is used for DTT services, which we consider likely, there is no need to include additional protection in the form of a protection clause.

A11.10 However, should services be deployed from locations that are one of the existing DTT transmission sites, receivers of existing DTT services in the immediate vicinity of the transmission site could suffer interference and may need protection. Similarly, the variation of a licence to a different (and at present unknown) use may lead to interference into incumbent DTT. Any changes to the transmission site or other technical parameters would require a variation of the licence, and Ofcom would consider inserting a protection clause in the relevant licence, at the time of variation.

A11.11 Interested parties considering services other than new DTT services in the interleaved spectrum should read Annexes 7 and 8 of the cleared consultation document[55].

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

Annex 12

Promoting competition and efficiency – further analysis

Introduction

A12.1 As discussed in section 10, we have taken a three step approach to promoting competition and efficiency.

- The first step involves using auction design and packaging to try to set the foundations for a well functioning market, and bring about (where relevant) a market structure which furthers competition.

- Step two of the approach involves considering whether there is a need for general safeguards to provide spectrum holders with sharper incentives to use spectrum efficiently and to promote competition through bringing about a more competitive market structure. These safeguards would apply to all spectrum holders irrespective of the use to which they put the spectrum. These remedies would generally involve imposing regulatory judgement on the outcome of a market and can impose significant costs if this judgement proved to be incorrect. As a result, we need to consider the costs and benefits of these interventions carefully before deciding to act.

- Step three of the approach involves considering whether there are specific award outcomes that have a significant likelihood of resulting in market structures that fail to promote fully competition and efficiency. In any such situation we would need to consider the specific issue and whether or not specific remedies – above and beyond those considered or imposed in steps one and two – might be required. In considering any such remedies we would need to have regard to their effectiveness and potential costs, such as the risk of unintended consequences.

A12.2 We discuss the application of step one in section 10. In that section we also summarise the outcome of our application of the next two steps. In this annex we set our analysis of the issues involved in applying these two steps in more detail.

General remedies under step two

A12.3 We set out here our consideration of possible general remedies under step two, as part of our discussion of our approach to competition and efficiency issues set out in section 10.

Use it or lose it requirements

A12.4 These conditions would be included as conditions in the licences to be awarded. Under them, spectrum owners could be required to give up their rights to spectrum if they were found to be not in use, or alternatively take action to address the underutilisation concerned. This potentially addresses any risk of inefficiency arising from speculative spectrum hoarding or from users holding spectrum idle for other reasons, and this resulting in inefficiency of spectrum use and/or a failure to fully promote competition.

A12.5 These conditions might be effective and hence beneficial in situations where it is clear that two conditions were met: that the spectrum was being held idle; and that such idle holding was inefficient. However, there are a number of drawbacks with these conditions. These include the following:

- It may in practice be difficult to define and so detect where spectrum is used or not. It is likely, for example, that spectrum owners will use their spectrum holdings for some purpose, even if it is not to the fullest extent possible. Additionally, spectrum owners may in any case be able to find ways of circumventing use it or lose it rules by for example finding limited and temporary uses for their spectrum.

- Use it or lose it requirements may foster rather than correct for inefficient spectrum use. In some situations it may be efficient for firms to hold spectrum idle, perhaps for sustained periods. For example, a firm may have judged it better not to use the spectrum while waiting for a particular market uncertainty to be reduced. Forcing spectrum use in such cases might encourage early and inefficient investment in particular services or markets.

- Use it or lose it conditions may also act as a significant barrier to efficient trading, where trading is predicated on a change of use or on a use which requires the spectrum to be unused for a period.

A12.6 Taking these considerations into account, we do not propose to introduce use it or lose it requirements into the licences made available in the geographic interleaved spectrum. This is because we think that the benefits of using this remedy are likely to be limited whilst the costs could be significant given the difficulty of detecting when idle spectrum is inefficient, which is particularly likely to be relevant here given the market uncertainty faced by some of the potential users of the geographic interleaved spectrum.

Rollout obligations

A12.7 These generally involve a licence condition which places an obligation on a licensee to rollout a network and services to cover a defined proportion of the UK population. The purpose of this remedy would be to ensure that service coverage is widespread across the UK, even in areas which may not be commercially attractive, in order to ensure both that spectrum is utilised and that citizens in these areas receive benefits.

A12.8 As mentioned above, the key purpose of this remedy is to ensure that networks and services are rolled out in areas where it may not be commercially attractive. Therefore, this remedy is likely to impose costs on spectrum holders and hence could make entry commercially unattractive in some situations. Alternatively, if entry still occurs, the remedy forces a cross subsidy which is paid for by other consumers, thus distorting the markets concerned.

A12.9 Therefore, this remedy should only be considered when there is evidence that the benefits of the additional rollout which it secures are likely to exceed the costs. However, even in this situation, a rollout obligation may not be the most cost effective approach to achieving the desired level of rollout. For example, where the service could also be provided through other means (i.e. over fixed infrastructure rather than by using spectrum or through alternative spectrum), such obligations risk distorting the provision of the service in a commercial and cost-effective manner, since they may impose additional costs on service providers and hence their wider consumer base. In such situations, as we set out in our DDR statement,

a more efficient approach is typically to fund provision of the desired additional services directly, with funding coming from bodies tasked with delivering or procuring relevant public benefits. Such an approach would ensure that the socially desirable level of rollout is achieve while allowing flexibility in how services are provided in different areas; it may be the case for example that different blends of inputs (spectrum at different frequencies, or different blends of spectrum and fixed infrastructure) deliver the same overall service at lower costs in different areas.

A12.10 In the DDR statement we considered whether there was evidence to suggest that a market failure could result from the citizen benefits of additional rollout being ignored by spectrum holders. We did not find evidence to suggest that this form of market failure would occur as a result of the geographic interleaved award, given the way in which geographic interleaved spectrum may be packaged and used. Additionally, as discussed above, even if this form of market failure were to occur we do not think that a rollout obligation would be the appropriate remedy, as direct funding can achieve these benefits in a more cost effective manner.

A12.11 Hence, we do not propose to introduce rollout conditions in the spectrum licensees to be awarded.

Information provisions

A12.12 The public availability of information regarding spectrum in the market and the uses to which it is being put can be very helpful in enabling existing and prospective spectrum owners to gauge the relative value of spectrum in relation to other inputs and so make efficient purchasing and production decisions, including within secondary markets for spectrum. Currently the availability of this information is relatively limited.

A12.13 The scope and nature of information that is most helpful for promoting efficient spectrum use and secondary markets will, at a high level, be concerned with the volumes and frequencies of spectrum awarded and the extent to which it is being used, so enabling a view to be taken on the amount of spectrum which is potentially available for other uses which may emerge in the future.

A12.14 In response to concerns about the limited availability of such information, we have decided to include in the 2.6 GHz award[56] a standard condition in the licences for the 2.6 GHz and 2010 MHz bands which requires licensees to provide us, on request, with general information regarding their equipment and use of frequencies, or the rollout of their network. We further noted that we may from time to time publish aggregated information received on the number of base stations and frequencies used in areas across the UK, in order to help secure optimal use of the spectrum and facilitate trading.

A12.15 We consider that such an approach could have general merit in respect of the geographic interleaved award (and in the cleared award). The form such a condition might take is discussed in section 10. We think that the costs of the approach are limited. However, we note that in adopting any such approach one concern would be the need to recognise appropriately any commercial confidentiality concerns that the public release of certain data might raise. Conversely, we think that the benefits of the approach are potentially significant. This is because, given the likely importance and scarcity of the geographic interleaved spectrum, inefficient

[56] See http://www.ofcom.org.uk/consult/condocs/2ghzrules/statementim/statement/statement.pdf

spectrum use, even for relatively short periods of time, could impose significant costs on UK citizens and consumers.

Access requirements

A12.16 Where the control of spectrum is concentrated in a few hands, with the consequent potential to result in a market structure in which competition could be further promoted, it may be helpful to require spectrum holders to make the spectrum available in some manner to third parties; i.e. to impose access requirements. This could in some situations promote downstream competition. Forms of access conditions have been proposed and used for example in the recent auction for 700 MHz spectrum held in the United States of America by the Federal Communications Commission (FCC). The exact form of condition that may be most effective will depend on the circumstances under consideration.

A12.17 The manner of access requirements can vary, in that they can be tied to one or more elements of service or asset under the control of the licensee. At a most basic level, access could be given to the spectrum itself, on specified terms. On the other hand, access could be given to services which are provided using spectrum, or to other inputs (apart from spectrum) required for the service. For example, it could involve access to the network, so implicitly including necessary infrastructure such as towers and transmitters, or to wholesale services such as roaming.

A12.18 Access conditions can be advantageous when they allow a spectrum auction to arrive at a more efficient outcome even when this might not appear directly to promote competition in downstream markets. This type of situation may arise, for example, when the efficient use of spectrum requires a small number of networks to be deployed and hence the emergence of relatively concentrated market structures at the network level (as the spectrum required per network is large compared to the available spectrum), but when the provision of these services to end users in a downstream markets can efficiently support a larger number of players (i.e. a less concentrated downstream market structure).

A12.19 These conditions tend to be most effective where the requirement for downstream access to wholesale services or spectrum is clear cut and where access conditions can be tailored to the circumstances.

A12.20 Nevertheless, even in these circumstances, access conditions can be complex to specify and difficult to implement effectively. For example, it may be necessary to specify the terms on which access is to be provided. This requires careful assessment of the costs that the wholesale provider incurs in providing wholesale access and the impact of this on the incentives of the provider to develop or improve services. Terms which are too generous to the downstream players for example could risk unintended consequences such as a relative lack of investment in network services by the wholesale provider.

A12.21 Bearing in mind both the potential uses and fragmented geographic nature of spectrum in the geographic interleaved awards it is not at all clear that a general access remedy would be appropriate. This is for the following reasons:

- A likely use for geographic interleaved spectrum will be DTT broadcasting. The form of broadcasting applications will depend on award outcomes; it may be the case for example that geographic interleaved spectrum is used for a number of metropolitan type local or regional services. In this case, access requirements are unlikely to promote competitive outcomes and could risk discouraging bidder

participation. We do not consider that it is appropriate therefore to design and impose some form of general access requirement even where we have some degree of knowledge about the likelihood of the broad application.

- There are in addition a variety of potential other uses of the geographic interleaved spectrum and associated possible downstream markets. The form and hence benefits of a general access requirement are therefore hard to see; it is not at all clear that one form of access requirement would facilitate all possible types of downstream competition. Conversely, the costs and unintended consequences of this approach might be significant; onerous or inappropriate access conditions could distort interest and the market for spectrum.

- Access conditions are generally more suitable for facilitating competitive downstream market structures in specific situations (when the terms of access can be tailored to the particular problem). This is because access conditions may be expected to be more effective where they are targeted at specific issues when there is a clear cut case for downstream market players to be provided access to the wholesale services afforded through use of spectrum.

A12.22 Overall we do not think there is a case for applying a general access condition to all of the potential uses of the geographic interleaved spectrum. Access conditions can have significant unintended consequences, and hence should only be applied when there is a strong case for access being required to further promote competition or efficiency. There is no such requirement which applies generally to all of the potential uses of the geographic interleaved spectrum. Therefore we think that the benefits of general access conditions, which apply to all uses, are limited and the costs are potentially significant. The specific issues raised by the potential acquisition of geographic interleaved spectrum by individual potential bidders such as Sky and NGW/Arqiva are considered separately under our analysis of step three (both below and in section 10).

Spectrum caps

A12.23 Spectrum caps work by limiting the amount of spectrum that an individual party may hold. Their purpose is to promote diversity of spectrum holdings (i.e. to guard against outcomes where the award results in a very small number of players holding all of the spectrum), and hence facilitate the emergence of more competitive market structures which can help to foster efficient spectrum use.

A12.24 We set out below the forms spectrum caps might take, whether or not there might be a case for applying a general spectrum cap in respect of geographic interleaved spectrum, the advantages and disadvantages of this approach, and our conclusions.

A12.25 Spectrum caps can take a variety of different forms:

- Spectrum caps can be set as an absolute limit on the amount of spectrum any one party can hold (i.e. a hard spectrum cap), or can be set such that if the cap is exceeded, there are other conditions which may apply to the spectrum licence such as a different initial licence period (i.e. a soft spectrum cap).

- Spectrum caps can be set either loosely or tightly. A loose spectrum cap involves setting a cap at such a level that it has only limited impact on the uses to which the spectrum can be put by an individual party, but with the intention of being a general safeguard to prevent spectrum holdings becoming heavily concentrated.

A tight spectrum cap aims at constraining the structure of spectrum holdings and use more severely, and might be used where there are significant concerns that absent such caps there is a likelihood that more competitive market structures might fail to arise.

- Spectrum caps can either be set without reference to other spectrum holdings or can be set to take into account spectrum holdings across other spectrum bands. In this discussion we call the first type 'non-contingent' caps and the second type 'contingent' caps.

- Spectrum caps might be set to apply at the time of the award of spectrum only (e.g. each bidder in the auction might be restricted to a maximum purchase level) with no restriction on subsequent secondary market trades and holdings. Alternatively they might be set at the time of the award and endure afterwards.

A12.26 Spectrum caps are relatively simple to understand and implement. They are also likely to be effective in promoting a diversity of spectrum holdings and more competitive market structures both in the general sense and where a more targeted approach is required.

A12.27 However, for these benefits to be realised without undue costs requires careful judgement about the size and nature of the spectrum cap. Inappropriately tight caps for example risk eliminating spectrum award outcomes that would otherwise have been efficient. Given the size and nature of potential consumer and citizen benefits from spectrum use, the costs of any such distorted outcomes could be very significant. Alternatively inappropriately loose caps risk failing to have an effect and so failing to promote sufficiently more competitive market structures they are intended to.

A12.28 The nature of the cap which may be appropriate, and its costs and benefits, will depend upon the competition and efficiency considerations to be addressed by the remedy.

A12.29 For the cleared award, we concluded that it may be appropriate to apply a general safeguard cap of 50 MHz. Such a cap would provide an absolute limit on the amount of spectrum that any one party can acquire in the cleared award auction. It would be a cap that only applied at the time of the award, in that it would only limit the amount of spectrum which could be acquired in the at the time of the award, so that after the award individual licensees (including speculative licensees) could build larger holdings via the secondary market if this represented the most efficient market outcome.

A12.30 We reached this conclusion for the cleared award for the following reasons:

- It would promote diversity of spectrum holdings, and so help to promote more competitive market structures.

- Provided it was set at a reasonable level, it would not, we believe, unduly constrain the potential uses of the cleared spectrum, and hence would not impose significant costs.

- The cap was proposed to be set out at a level which would amount to around 40 per cent of the national cleared spectrum available, sufficient for example for a single winner to deploy a full national multiplex using a multi-frequency DTT

network or deploy a national mobile broadband network which supported high data rates.

A12.31 For the geographic interleaved award, we have considered whether or not a safeguard spectrum cap might offer similar benefits, either as a standalone cap within interleaved geographic spectrum itself, or by extending the scope of the proposed 50 MHz safeguard cap to include geographic interleaved spectrum in some way.

A12.32 In the case of a standalone spectrum cap for geographic interleaved spectrum, we do not see strong benefits of such an approach compared with potential downsides. This is for the following reasons:

- The effective frequency range likely to be awarded at any one location is rather narrow in comparison to the cleared award; assuming that two single channel lots are offered at any one transmitter site, our packaging proposals would imply a frequency range available for auction of 16 MHz in any location. Hence the scope for and benefit of diversity of holdings at each location will be limited.

- Similarly, imposing a spectrum cap that limits holdings to any fraction of geographic interleaved spectrum available at any location could be costly. This is because it would risk limiting the uses to which the spectrum might be put in each area and so has the potential to result in lost economic opportunities. Conversely setting a spectrum cap on a frequency basis at a level higher say at 16 MHz is unlikely to have any effect on bidding behaviour or award outcomes given our packaging proposals.

- Alternatively, setting the cap by restricting the total number of geographic interleaved lots that may be purchased by any one party (i.e. capping the holding of spectrum in geographic rather than frequency terms) would similarly risk unduly restricting possibilities for aggregating lots to achieve a particular geographic footprint of service coverage or to some extent substituting lots, with consequent risks for inefficient allocation outcomes.

- Our proposal to phase the award of geographic interleaved in a series of processes means that the imposition of some form of cap on all the auctions would introduce difficulties and possible inefficiencies in respect of bidders who were looking to acquire spectrum over all the phases. A cap might for example inappropriately deter some bidders from acquiring spectrum in an earlier phase.

A12.33 Accordingly, the benefits of a safeguard cap for geographic interleaved spectrum in isolation are likely to be limited and the risks and costs potentially large.

A12.34 We also consider at this stage that it will also not be appropriate to extend the scope of the 50 MHz safeguard cap proposed for the cleared spectrum to include geographic interleaved spectrum contingent on cleared award outcomes. This is for the following reasons:

- The spectrum cap proposed for the cleared award is intended to be a general safeguard cap aimed at promoting a diversity of spectrum holdings. For example by guarding against outcomes where spectrum holdings are heavily concentrated. Hence, we believe that the proposed cap in the cleared award is likely to be sufficient to achieve our goal. Extending the cap into the geographic interleaved award could further promote diversity, as it could prevent the outcome of a bidder who acquired cleared spectrum up to the level of the proposed cap

also acquiring a significant proportion of geographic interleaved spectrum. However, we do not think there would be sufficient additional benefits from using a safeguard cap to prevent this outcome, given the potential costs (as discussed below). This is because if this outcome were to arise, we think there would be a sufficiently diversified outcome (i.e. given the level of diversity provided for by the 50 MHz cap this is unlikely to result in an outcome where spectrum holdings are too heavily concentrated).

- Additionally, we think that extending the cap could impose costs. This is because it may limit the opportunities for bidders to acquire spectrum in the geographic interleaved award to complement their acquisition of cleared spectrum (as discussed in section 4).

- Finally, our proposal to auction the spectrum in a series of awards could, in combination with an extended cap, introduce a further constraint on bidder options over the course of all the awards, and so introduce a further source or risk and uncertainty for bidders. Under such circumstances a bidder for example might feel unduly constrained from purchasing spectrum in an early award in order to minimise the chances of breaching the spectrum cap following the outcome of the subsequent awards. Such constraints risk unduly distorting award outcomes.

A12.35 For these reasons, we do not at this stage see a strong case for extending the scope of a general remedy of a 50 MHz safeguard cap, of the form proposed for the award of cleared spectrum, to the award of geographic interleaved spectrum. Nevertheless we remain open to views on this issue.

A12.36 In summary, we do not at this stage consider that a spectrum cap in respect of the geographic interleaved award, either on a standalone basis or linked in some way to the general 50 MHz safeguard cap proposed for the cleared award, is necessary.

Specific issues under step three

A12.37 As set out in section 10, our assessment of possible spectrum award outcomes and the potential for these to result in market structures which could be more competitive highlights that, in most cases, we concluded that any concerns about the likely market structure were not sufficiently significant to warrant further consideration.

A12.38 However, our assessment identified two particular issues for which we consider that there is sufficient potential for the market structure to be less competitive than it might otherwise have been. We set out here our consideration of these two specific issues, including our assessment of whether these possibilities merit some form of explicit intervention in the award of geographic interleaved spectrum.

Sky on DTT

A12.39 The potential acquisition and aggregation of geographic interleaved spectrum by Sky in order to launch pay TV services on the DTT platform could result in principle result in a market structure which fails to fully promote competition. The scale of this effect would be related, among other things, to the coverage any acquisition of geographic interleaved might provide. As we noted in section 4, coverage provided through geographic interleaved spectrum could be limited in comparison to that provided under cleared spectrum in a number of channels.

A12.40 However, other considerations are also relevant. Within the last year we have published two consultation documents which are relevant to this assessment. These are firstly, the Pay TV market investigation[57] and secondly, our assessment[58] of Sky's proposal to remove the three free to air channels that it currently provides on the DTT platform and replace them with pay TV channels (often known as Sky's 'Picnic' proposal). We have not reached definitive conclusions on the issues considered in either of these documents, which acknowledge competition concerns raised at various levels of the supply chain for pay TV services. However, our analysis here takes into account the issues identified in these documents in relation to the potential for Sky to have market power, primarily in relation to the potential existence of any wholesale markets for premium content (likely to include first run Hollywood movies and particular types of sports content), and the possibility for this market power, if it exists, to be leveraged into other markets, and as a result for the potential for more competitive market structures to be forgone.

A12.41 If Sky does have market power over wholesale markets for access to premium content, then it is possible that an acquisition of sufficient geographic interleaved spectrum, coupled with this control of premium content, could raise competition concerns such as:

- the potential to foreclose further development of competition in terrestrial broadcasting; and
- the potential to leverage any possible market power arising from control of premium content into retail markets across platforms.

A12.42 Both of these effects, were they to occur, could prevent the emergence of more competitive market structures and might not further the interests of consumers. However, in order to assess whether these effects raise a competition concern which we should seek to address through the geographic interleaved awards, we need to consider carefully the source of the concern.

A12.43 A key driver of the concern is, as highlighted above, the extent to which Sky has control over any wholesale markets for access to premium content. The less access that other providers have to such premium content, all other things being equal, the greater the extent that Sky may be able to act independently in terms of pricing and leverage in pay TV markets across all platforms, including any established through the creation of one or more further DTT multiplexes using the digital dividend spectrum. However, this concern is not directly linked to the impact of a potential acquisition of geographic interleaved spectrum by Sky and its result on the market structure which might emerge.

A12.44 A second relevant driver is the extent to which, were Sky to rollout a further DTT multiplex to offer its services, other pay TV participants or potential entrants might have access to other DTT capacity and so be able to bring about more competitive market structures. We note that some potential exists for the digital dividend to yield more than one multiplex. Additionally, there is the potential for existing capacity on the DTT platform to be upgraded and expanded in the future. To the extent that such capacity is offered to market by the existing DTT multiplex operators on a comparable timescale to Sky's potential acquisition of digital dividend spectrum, other pay TV market participants or potential new entrants could also use this to enter the platform and act as a competitive constraint at that point. However, it may

[57] See http://www.ofcom.org.uk/consult/condocs/market_invest_paytv
[58] See http://www.ofcom.org.uk/consult/condocs/dtv/

be the case that Sky's market position in relation to premium content could limit the ability of new entrants to compete effectively through either of these routes.

A12.45 Overall, we see the question of access to premium content as the central issue in relation to the potential for there to be competition concerns arising in relation to Sky's market position. This issue is not primarily linked to the potential for Sky to acquire geographic interleaved spectrum, or to the impact this might have on market structure. To the extent that other issues have been raised regarding competition concerns in the provision of pay TV services, we similarly do not believe that these would suggest a case for intervention in relation to the potential for Sky to acquire geographic interleaved spectrum. Additionally, we recognise that any concerns arising from the potential for Sky to acquire geographic interleaved spectrum is likely to be less than the concerns which may arise from a potential acquisition of cleared spectrum by Sky, given the more limited coverage afforded by geographic interleaved spectrum.

A12.46 These considerations would suggest that any competition concerns are best pursued through our existing initiatives concerning 'Picnic' and our wider review of the pay TV market. However, we recognise that we may need to keep this under review.

NGW / Arqiva

A12.47 The geographic interleaved spectrum could be used to rollout additional DTT multiplexes, which could be used to provide wholesale multiplex capacity services. Again we note in this context that the coverage provided through geographic interleaved spectrum could be limited in comparison to that provided under cleared spectrum in a number of channels, and that this will tend to reduce the utility of any such services compared to what might be achieved through the cleared spectrum.

A12.48 Competition in the provision of wholesale services on the DTT platform is an issue which was considered briefly in the context of the acquisition by Arqiva's owner Macquarie of NGW. Here we consider the potential impact of the merged entity acquiring geographic interleaved spectrum in order to create and operate additional DTT multiplexes, and as a result, increasing its market share at the multiplex layer in the value chain and hence impacting on the resulting market structure.

A12.49 The main elements of the DTT supply chain are set out in the table below.

Table A12.1 DTT supply chain

Value chain layer	Description of the services provided
Transmission provider – In relation to DTT NGW and Arqiva provide all Managed Transmission Services (MTS) and Network Access (NA)	MTS - a package of services including some or all of network design, procurement and installation of transmitters, network monitoring, quality assurance of the signal and maintenance of the transmission equipment and procurement of Network Access.
	NA - a package of services as defined as providing access to transmission sites and infrastructure including masts, antenna, combining units (if required), on site buildings and access to utility services. NA contracts can

<table>
<tr><td colspan="2"></td><td>include the design and installation of specific equipment including new antenna.</td></tr>
<tr><td colspan="2">Multiplex owners – there are currently six multiplexes operated by the following organisations:</td><td rowspan="3">DTT is delivered by multiplexing a set of channels that are then broadcast. There are six existing multiplexes.

One of these (Multiplex 1) has been allocated by the government to the BBC under its Charter and Agreement.

The remainder are licensed by Ofcom to the corresponding licensee. Each multiplex operator (licensee) therefore in principle acts as a gate keeper to spectrum currently necessary for DTT.

Multiplex owners acquire MTS from a transmission provider (who in turn will need to ensure they have appropriate NA Agreements with the site owner).</td></tr>
<tr><td>Multiplex</td><td>Licensee</td></tr>
<tr><td>1
2

A
B
C
D</td><td>BBC
Digital 3&4 (ITV/Channel 4)
SDN (ITV)
BBC Free to View Ltd
NGW
NGW</td></tr>
<tr><td colspan="2">Broadcaster – there are currently in the region of 35 television channels broadcast over the DTT platform</td><td>Broadcasters acquire multiplex capacity from multiplex operators. Their services include capacity on a multiplex which is broadcast from a number of transmission sites.</td></tr>
<tr><td colspan="2">Viewer reception – there are in the region of 17 million TV sets capable of receiving DTT services</td><td>Viewers access the channels broadcast over the DTT multiplex though an aerial and a digital ready television (IDTV) or a set-top box, which decodes the services.</td></tr>
</table>

A12.50 As indicated in the table above, both MTS, excluding spectrum, and NA are subject to ownership and control by Arqiva and NGW. In April 2007, Arqiva's owner Macquarie UK Broadcast Ventures Limited acquired NGW.

A12.51 In view of possible competition concerns arising from this, the completed acquisition was referred to the Competition Commission (CC) in August 2007. The CC found, among other things, that the acquisition could be expected to lead to a substantial lessening of competition in the provision of MTS/NA services. After consideration of relevant potential costs and benefits of the acquisition, the CC in March 2008[59] approved the acquisition, subject to the successful negotiation of a number of behavioural undertakings. If undertakings are not agreed, a partial divestment is likely to be required. In the meantime NGW operates as a separate economic entity under hold-separate undertakings.

A12.52 At the platform layer, as indicated above, there are six multiplexes which are ultimately controlled by four different parties (the BBC, Digital 3&4 (joint venture

[59] See Competition Commission's final report at http://www.competition-commission.org.uk/rep_pub/reports/2008/fulltext/537.pdf

between ITV[60] and Channel 4), SDN (owned by ITV plc) and NGW). Three of these multiplexes (A, C, D) are referred to[61] as 'commercial multiplexes'; that is, their multiplex operators do not carry any public service content and are not under any regulatory requirements to achieve specific levels of coverage. The capacity on these multiplexes is therefore available to parties interested in purchasing services. These operators are required to make this capacity available on fair, reasonable and non-discriminatory terms. The other three multiplexes (1, 2 and B) are referred to as 'PSB multiplexes'. These have an obligation to match the coverage of the existing analogue terrestrial networks (estimated as being 98.5% of UK households) and are used to carry PSB channels. Therefore, NGW currently controls two out of the three multiplexes used to provide services to non-PSB broadcasters.

A12.53 A scenario that could arise as a result of the cleared and geographic interleaved awards is the acquisition by the merged NGW/Arqiva of spectrum for use for one or more further commercial DTT multiplexes, including for example the possibility that a multiplex created through the acquisition of geographic interleaved spectrum is an addition to one acquired through the cleared spectrum. This could in principle significantly increase the share this entity has of the provision of multiplex services to commercial broadcasters.

A12.54 However, the impact of this will depend upon whether other wholesale broadcasting services – either multiplex capacity provided on PSB multiplexes, or wholesale platform services provided on other technology platforms - compete with those offered by NGW/Arqiva. For example, a party seeking broadcast services might in principle be able to find other entities that can provide these services, either via alternative access to terrestrial DTT platform through PSB multiplexes, or through broadcast services provided on other technology platforms. Both routes might ensure more competitive market structure to emerge even in the case where NGW/Arqiva had increased its share of commercial multiplex capacity. We further note that the nature of the geographic interleaved spectrum available would not necessarily afford NGW/Arqiva full UK coverage (even if such coverage was required commercially).

A12.55 Given the uncertainties over the likelihood and scale of any potential competition concern which could arise, it is not clear to us that an acquisition of a combination of cleared and geographic interleaved spectrum by NGW/Arqiva would give rise to sufficient concerns to suggest intervention in the award of the geographic interleaved spectrum. And even if we were to have such concerns, these would need to be set in the context of the costs and risks of any effective remedies.

A12.56 If there were to be significant competition concerns, an effective remedy implemented through the geographic interleaved award would be to prohibit or limit the acquisition of digital dividend spectrum in the auction. We think this form of remedy would be undesirable as it would have a number of possible unintended consequences such as:

- the loss of opportunities that such acquisition might afford for economies of scale or scope; and

- a missed opportunity to allow enhanced coordination abilities. An additional multiplex may give NGW/Arqiva an improved ability to coordinate fully and efficiently decisions, when decisions are required at the level of part or all of the

[60] Channel 3 licensees
[61] In the context of DSO

DTT platform (i.e. when deciding upon whether and/or how to upgrade further or expand the platform).

A12.57 Given the uncertainty over whether a competition concern would arise (i.e. whether a market structure which fails to fully promote competition could emerge) and the significant risks involved in seeking to remedy this through limitations on spectrum acquisitions by particular individual parties in the geographic interleaved award, we take the view at this stage that it would be both disproportionate and create risks of unintended consequences if we were to intervene further in relation to the potential for NGW/Arqiva to acquire geographic interleaved spectrum. As a separate issue, we note that in the case that any anti-competitive behaviour were to arise, we would be able to seek to resolve this through our regulatory or competition powers as appropriate.

Annex 13

Impact Assessment

Introduction

A13.1 The analysis presented in this annex represents an impact assessment, as defined in section 7 of the Communications Act 2003 (the Act).

A13.2 You should send any comments on this impact assessment to us by the closing date for this consultation. We will consider all comments before deciding whether to implement our proposals.

A13.3 Impact assessments provide a valuable way of assessing different options for regulation and showing why the preferred option was chosen. They form part of best practice policy-making. This is reflected in section 7 of the Act, which means that generally we have to carry out impact assessments where our proposals would be likely to have a significant effect on businesses or the general public, or when there is a major change in Ofcom's activities. However, as a matter of policy Ofcom is committed to carrying out and publishing impact assessments in relation to the great majority of our policy decisions. For further information about our approach to impact assessments, see the guidelines, Better policy-making: Ofcom's approach to impact assessment, which are on our website: http://www.ofcom.org.uk/consult/policy_making/guidelines.pdf

A13.4 We have already consulted on our approach to the award of the spectrum freed up by digital switchover for new uses. Our analysis of the policy options relating to the general approach has been set out in two previous impact assessments, the first as part of our December 2006 Consultation and the second updated version as part of our December 2007 Statement. These assessments included consideration of the approach to the award of both cleared and interleaved spectrum as well as spectrum which was not cleared as a direct consequence of DSO and which is currently used for other services (i.e. channels 36 and 69).

A13.5 The analysis of options undertaken in this first phase of work, and as summarised in the two previous impact assessments, led us to conclude that a market led approach was more likely to meet our objective for the DDR than the alternative, interventionist approach. We found that certain specific measures were justified in the case of two services: PMSE and local television. The measures in respect of local television were to release geographic lots of interleaved spectrum suitable for, but not limited to, this service, which we will award by auction.

A13.6 Having established the approach we will take to the geographic interleaved awards, we now consider the method by which we will award the spectrum. This consultation focuses on the method and process for the auctions of geographic interleaved lots in the bands 470-550 MHz and 630-790 MHz.

A13.7 Two other consultations published in parallel with this document focus on the method and process for the award of:

- cleared spectrum; and
- spectrum to a band manager with obligations toward PMSE.

The citizen and/or consumer interest

A13.8 Our primary duties are to further the interests of citizens in relation to communications matters and to further the interest of consumers, where appropriate, by promoting competition. In the first phase of the DDR, the potential benefits to citizens and consumers were the focal point of our analysis. When deciding between the competing policy options for our approach to the award, we were guided by the total value each one of them could generate for society, including the benefits for consumers, for producers and for citizens.

A13.9 In this, the second, phase of the DDR, we can further improve the outcome of this award of spectrum for citizens and consumers by careful design of the spectrum packages, detailed auction format and rules and the licence terms and conditions. This will involve balancing some key trade-offs. For example, the technical licence conditions must protect existing users of the spectrum, and by extension, the citizens and consumers who use these services, while at the same time maximising its usability for new uses. Also, the spectrum packages should be flexible enough to accommodate the different potential uses, thereby promoting competition and innovation and resulting in more choice, new services and better prices for consumers, while at the same time reflecting the specific constraints that apply to the spectrum.

Our policy objective

A13.10 Our overarching objective in releasing the digital dividend is to maximise the total value to society generated by the use of this spectrum over time.

Options considered

A13.11 There are a number of ways that we can achieve this objective in our design of this award. We can:

- choose appropriate technical licence conditions that consider the need to protect existing users of spectrum while maximizing flexibility for new uses;
- choose appropriate non-technical usage rights which provide certainty of tenure and help to promote efficient outcomes
- design spectrum packages which best reflect the demand for the spectrum and the specific technical constraints on the spectrum;
- design an efficient auction process that promotes competition and encourages bidders to express their true value for the spectrum; and
- consider whether further remedies may be required to ensure that competition and efficiency are promoted through the award and use of the spectrum.

A13.12 For each of these areas, we have considered several options and our full analysis of these options is set out in the consultation document. In the remaining part of this impact assessment, we summarise our analysis in respect of the key issues for the DDR geographic interleaved awards and cross reference this to the relevant sections in the main body of the document.

Analysis of the different options

Choice of technical licence conditions

Type of condition

A13.13 One of the key issues for this award is the type of technical licence condition that should be included in the licences of available spectrum. We have considered two main options:

- Transmit masks (Block Edge Masks)
- Spectrum usage rights (SURs)

A13.14 Table A13.1 sets out a summary of our analysis (these issues are discussed further in paragraphs 8.3-8.7 of section 8):

Table A13.1 Transmit masks or SURs

Options	Advantages	Disadvantages
Transmit mask	Tried and tested Simple to understand Relatively easy to assess compliance Allows for a level of flexibility to deploy different types of service	Restricts ability to optimise power/density trade off in transmission networks Difficult to estimate the expected interference levels from neighbouring licensees, though the narrower range of uses in this award makes this less of a drawback
SUR	Provides a higher level of interference protection and certainty to neighbours than mask-based licences Allows flexibility to deploy different types of service Especially suitable for spectrum where there is wide range of possible uses	More complex to define and compliance assessment is not as straightforward as for mask-based licences

A13.15 In the case of geographic interleaved lots, we believe that the relatively narrow range of likely uses tilts the balance in favour of transmit masks and propose that technical licence conditions should be presented in this form.

Protection options

A13.16 We considered three options for post-DSO protection where there is overlapping coverage. Section 5 and Annex 5 sets out our thinking. We set out our analysis of the options in the following table:

Options	Advantages	Disadvantages
DPSA only	Of 3 options, allows highest coverage level for new services Illustrative economic cost benefit analysis marginally favours this option	Of 3 options, requires highest level of remedial measures and costs required (aerial replacement or repositioning) Does not protect relevant national service; i.e. does not take account of national or regional borders and hence need to deliver appropriate national service to relevant households Does not protect about 100 of the existing analogue relays
Median	Coverage level for new services similar to DPSA option Illustrative economic cost benefit analysis case similar to DPSA only option Affords protection to all transmission sites, including about 100 not covered by DPSA option Can include protection of relevant national service	Slightly higher interference allowed, compared to JPP option
JPP	Remedial costs relatively low	Of three options, coverage levels for new services significantly worse Of 3 options, illustrative economic cost benefit case significantly worst

A13.17 The JPP option offers significantly reduced coverage for new services compared to both the DPSA only and Median options. Although remedial costs are also low under this option, the value of new services is likely to outweigh these considerably and so the reduced coverage gives a significantly weaker economic case to this option overall. Coverage levels for the DPSA only and Median options, and hence economic case, are similar. We see advantages in the Median option affording protection to all transmission sites and for relevant national services and so on balance we favour the Median option.

Non-technical usage rights - interoperability

A13.18 Existing DTT multiplex operators are required to adopt certain technical standards and operating parameters. This means that viewers benefit from receiving a common service across all six existing DTT multiplexes. Given the possibility that interleaved spectrum will be used to deliver new DTT services, we have considered the issue of interoperability with the existing multiplexes and the extent to which regulatory intervention may be needed to secure this. We have identified and analysed three options as set out in Table A13.2 below:

Table A13.2 Interoperability options

Options	Advantages	Disadvantages
Do nothing	Potentially consistent with our duty to regulate only where necessary if no need for interoperability Likely to be benefits (and therefore incentives) for all multiplex operators in interoperating voluntarily to maximise viewer benefits	Not guaranteed to deliver interoperability Our ability to intervene subsequently in favour of interoperability would be limited
Facilitate	Preserves our preference for operators to come to interoperability agreements voluntarily Gives us the ability to intervene decisively if circumstances frustrate such agreements	Does not guarantee viewers the benefits of interoperability across all multiplexes at the earliest possible time
Mandate	Guarantees viewers the benefits of interoperability across all multiplexes	Automatically precludes alternative market offerings that could deliver different, possibly greater benefits to viewers In the absence of a compelling reason to intervene in this way, sits ill with our duty to regulate only where necessary

A13.19 We propose to facilitate interoperability between existing and new multiplex operators at the request of the latter. We consider this option to be the most proportionate response to address the issue as we perceive it.

Packaging

A13.20 For the geographic interleaved auction, we have already stated that we will award one or two packages suitable for but not reserved for local television in about 25 locations with known or likely demand for this use, and that we plan to award lots in respect of locations for three existing RTSL holders (Caldbeck, Winter Hill, and

Wenvoe). The main remaining issue is to decide the extent to which further lots might be auctioned.

A13.21 The question of further lots will primarily turn on the extent to which there is demonstrable demand for lots. Following our January 2008 Stakeholder event, we received expressions of interest for local TV broadcasting which indicated interest in 18 locations and hence lots; 10 of these were already in the list of 25 locations given in our DDR statement. We may receive further expressions of interest.

A13.22 We note in addition that NGW has carried out and we will publish during the course of this consultation technical work on a total of 81 transmitters and hence lots.

A13.23 We have considered four main options for the number of lots to be awarded. These are summarised in the table below and are discussed further in paragraphs 6.3-6.42 of section 6.

Table A13.3 Options for auctioning lots

Option	Advantages	Disadvantages
1. 3 existing RTSLs and 25 lots given in Statement	- Interest likely in acquiring licence for all locations - Hence reduces chances of unsold lots	- Could restrict possibilities for interested parties to participate - Does not necessarily meet all expressions of interest - Limiting locations substitutes Ofcom for market judgement
2. 3 existing RTSLs and 25 lots given in Statement, *plus* 46 remaining sites out of whole set of 81	- Large set of lots put to auction - Allows market to judge which lots are attractive	- Increased risk of unsold lots and costs of administrating unnecessary auctions - Does not necessarily meet all expressions of interest
3. 3 existing RTSLs and 25 lots given in Statement, *plus* 8 new expressions of interest, *plus* Potential expressions of interest	- Provides opportunity for purchase where there is an expressed demand - Reduces chances of unsold lots	- Need to invite and judge further expressions of interest
4. 3 existing RTSLs and 25 lots given in Statement, *plus* 46 remaining sites out	- Maximizes set of lots put to auction - Provides opportunity for purchase where there is	- Increased risk of unsold lots and costs of administrating unnecessary auctions

of whole set of 81, *plus* 8 new expressions of interest, *plus* Potential expressions of interest	an expressed demand	- Need to invite and judge further expressions of interest

A13.24 Overall, we consider that option 3 best reflects the need to maximize opportunities for interested parties to participate in the auction against the need to minimize unnecessary administrative costs and cost of technical studies associated with putting lots to auction.

Sequencing and timing of the awards

A13.25 For the geographic interleaved award, in determining the timing and in particular whether to hold a series of awards or a single award, we considered the interests of two broad sets of user of geographic interleaved spectrum; those users wishing to purchase a number of lots for aggregation, and those users more interested in one or a few lots, for local use. Bearing this in mind, we identified three basic options for timing of the awards. The table below summarises these, and they are discussed further in paragraphs 6.43-6.45 in section 6. We have sub-divided option 1 into award in winter 2008/09 or in late 2009.

Table A13.4 Options for timing of the awards

Option	Advantages	Disadvantages
1.(a) A single award of all available lots in winter 2008/09	- Releases spectrum onto market as soon as possible - Addresses aggregation risk - Would meet needs of existing 3 RTSLs	- For bidders interested in local lots, may be too early to secure public funding - Short timescale means that in practice this is unlikely be a viable option Threshold risk
1.(b) A single award of all available lots in late 2009	- Addresses aggregation risk - More practicable timetable	- Would require temporary measures for three RTSLs, and extends uncertainty for these operators - Might still be too early for bidders interested in local lots to secure public funding - Threshold risk

2. An award of medium lots for Caldbeck, Winter Hill and Wenvoe in winter 2008/09 followed by a single award of all remaining (large and medium) lots in 2009	- Would meet needs of existing 3 RTSLs Addresses aggregation risk	- Might still be too early for bidders interested in local lots to secure public funding - Threshold risk
3. An award of medium lots for Caldbeck, Winter Hill and Wenvoe in winter 2008/09; a single award in late 2009 of all large lots; and awards linked to the DSO timetable for all remaining medium lots.	- Would meet needs of existing 3 RTSLs - May help to allow bidders interested in local lots to secure public funding in advance of auction - Substantially addresses aggregation risk, for 'aggregatable' lots - Reduces threshold risk	- May limit substitution possibilities between large and medium lots

A13.26 Overall we consider that option 3 meets best our stated commitments and objectives for the award. It allows an efficient simultaneous award of the lots which can be most expected to be complements and substitutes. It recognises that bidders interested in more local and smaller lots may need later award in line with DSO in order to resolve funding uncertainties given that they may wish to secure public funding in advance of the auction.

Auction design for initial phased award

A13.27 We summarise here the auction design options that we have considered for the initial phased award of spectrum; that is, the award in winter 2008/09 of lots for Caldback, Winter Hill and Wenvoe. These options are discussed further in paragraphs 7.1 to 7.67 of section 7. In addition, Annex 7 sets out the factors than can affect the efficient outcome of an auction and possible auction formats. The initial phased award is for three separate lots and we have considered two candidate single unit auction format options: a sealed bid auction or an ascending bid auction. For the reasons set out in Annex 7, we would adopt a second price rule under either format.

A13.28 Table A13.5 sets out the advantages and disadvantages.

Table A13.5 Options for the auction design for initial phase awards

Option	Advantages	Disadvantages
1. Sealed bid auction	- Simple and straightforward	- Does not permit bidders to learn from others during a price discovery

		process
2. Ascending bid auction	- Allows bidders to see development of prices and hence facilitates efficient price discovery	- Slightly more complex than sealed bid auction

A13.29 Given that these items of spectrum have not been subject to market valuation before, and that there might well be bidders with similar business cases who share some degree of common value uncertainty, we think we should place weight on the need for any auction format to facilitate price discovery .This would suggest the use of an ascending bid auction. Although in principle this auction format is more complex than a sealed bid auction, we believe that it is not significantly more complex and that with careful design of the auction process, the process can be made to be relatively straightforward and user friendly from the bidders' point of view. These considerations support the use of an ascending bid auction.

Auction design for combined award and further phased awards

A13.30 For the combined award we have considered that either a combinatorial clock auction (CCA) format or a standard simultaneous multiple round auction (SMRA) format would be suitable, but we have a preference for the former. The reasons for this are set out in paragraphs 7.16-7.27 of section 7. We shall take account of responses to this consultation in deciding which to adopt. We shall consult later in 2008 on our proposal for the format and key auction rules and include an impact assessment in that document.

A13.31 The later phased awards have similarities to the initial phased award discussed above. Although there may be larger numbers of licences available, interest is still likely to include bidders interested in local service provision. We therefore favour an ascending bid auction for each lot to be awarded. The reasons for this are set out in paragraphs 7.29-7.32 of section 7. This proposal is provisional on the outcome of this consultation.

Promoting competition and efficiency

A13.32 We have considered how the award of geographic interleaved spectrum can best promote competition and efficiency in downstream markets. Beyond taking into account the need to promote competition and efficiency through auction design and packaging, we have considered:

- the need for general provisions and safeguards to provide spectrum holders with sharper incentives to use spectrum efficiently and to promote competition. These safeguards would if adopted apply to all spectrum holders irrespective of the use to which they put the spectrum; and

- the risks of specific award outcomes resulting in a less competitive market structure than would otherwise be possible and identifying whether targeting intervention to prevent or resolve these particular outcomes would be an appropriate regulatory response to such risks.

A13.33 Key conditions for considering whether or not to adopt any remedies will be that:

- the remedy can be expected to be effective; and
- the cost of any remedy in terms of regulatory failure or unintended consequences is expected to be significantly outweighed by the significance and likelihood of the competition or efficiency issue.

A13.34 Table A13.6 sets out our consideration of options under general provisions.

Table A13.6 Options for general provisions

Option	Advantages	Disadvantages
Use it or lose it requirements	Effective and beneficial where it is clear that a significant risk exists that spectrum will be held idle and that such idle holding is inefficient	Difficult in practice to define and detect where spectrum is held idle May have unintended consequences where spectrum use is forced in circumstances where it is not efficient to do so Could act as significant barrier to efficient trading
Rollout obligations	Directly increases chances that spectrum is utilised and citizens receive benefits where rollout is not commercially attractive	Implies additional costs on spectrum holders and so may distort primary or secondary purchase of spectrum Other solutions are available to achieve same outcome more efficiently; e.g. direct funding Less relevant to geographic interleaved spectrum where lots are local
Information provisions	Publicly available information regarding spectrum ownership and use facilitates value formation, price discovery and hence efficient spectrum trading Likely to be effective in a range of circumstances and market outcomes	Need to recognise appropriately any commercial confidentiality concerns that the public release of the data might raise
Access requirements	Can be effective in promoting downstream competition in face of upstream scarcity of spectrum, particularly where nature of service and required	Access conditions can be complex to specify and difficult to implement; inappropriate terms could either unduly favour or penalise access provider and have unintended

	access is clear	consequences and costs For geographic interleaved spectrum, not clear what the nature of services to be provided through geographic interleaved spectrum is, hence difficult to specify any general access conditions which apply to potential uses
Spectrum caps	Relatively straightforward to understand and implement Can be effective structural solution, by reducing opportunities for less competitive market structures to emerge following award Can be used in general or specific manner	Requires careful judgement about level in order to minimise risks of unintended consequences Less effective in respect of geographic interleaved spectrum where there is less scope for diversity of ownership at each lot

A13.35 We discuss our approach to general provisions and options in paragraphs 9.34 to 9.66 of section 9.

A13.36 Overall we conclude that one general intervention may be appropriate: an information provision clause that will help facilitate an efficient secondary market.

A13.37 Regarding the risk of specific market failures, we have not identified any specific risks that require specific remedies in respect of the award of geographic interleaved spectrum.

Annex 14

Glossary of abbreviations

3G	Third-generation mobile-phone standards and technology
AIP	Administered Incentive Pricing
BEM	Block-edge mask
BERR	Department for Business, Enterprise and Regulatory Reform
CCA	Combinatorial Clock Auction
CEPT	European Conference of Postal and Telecommunications Administrations
dB	Decibel
dBµV/m	Decibel microvolts per metre
DCMS	Department for Culture, Media and Sport
DDR	Digital Dividend Review
DSO	Digital switchover
DTG	Digital TV Group
DTT	Digital terrestrial television
DVB-H	Digital Video Broadcast – Handheld
DVB-T/-T2	Digital Video Broadcast – Terrestrial. DVB-T2 is an advanced version, currently undergoing standardisation.
EU	European Union
FDD	Frequency-division duplexing
GE-06	Geneva 2006 Agreement
GHz	Gigahertz
HD	High definition
IMT	International mobile telecommunications
JPP	Joint Planning Project
MFN	Multi-frequency network
MHz	Megahertz
MPEG	Moving Picture Experts Group

mW	Milliwatt
PMSE	Programme-making and special events
PSB	Public service broadcaster
QAM	Quadrature Amplitude Modulation
QPSK	Quadrature Phase Shift Keying
RRC-06	Regional Radio Conference 2006
SD	Standard definition
SKA	Square Kilometre Array
SMRA	Simultaneous Multiple Round Auction
STFC	Science and Technology Facilities Council
SURs	Spectrum usage rights
TDD	Time-division duplexing
TLC	Technical licence condition
UHF	Ultra-High Frequency
UKPM	UK Planning Model
W	Watt
WiMAX	Worldwide Interoperability for Microwave Access
WRC-07	World Radiocommunication Conference 2007