



Access to interleaved spectrum for programme-making and special events after digital switchover

Statement

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Section 1

Executive summary

Digital switchover and impact on programme-making and special events

- 1.1 The Government has decided that analogue terrestrial television should cease in the UK by 2012. This will allow the expansion of digital terrestrial television (DTT) to cover as much of the country as analogue covers now. This programme of change—digital switchover (DSO)—will have three major consequences:
 - there will be an expansion in the number and range of services available via terrestrial television across the UK;
 - a large amount of spectrum—the digital dividend—will become available for new uses; and
 - the pattern of interleaved spectrum—the frequencies used by terrestrial television and shared by low-power applications, including for programme-making and special events (PMSE)—will change.
- 1.2 PMSE is one of the key sectors using interleaved spectrum. It makes a major contribution to the UK's social, cultural and economic well-being. It comprises a very wide variety of organisations and individuals using spectrum for an equally wide variety of uses. There are many thousands of business and professional users in broadcasting, entertainment and events and many more among charities and community organisations.
- 1.3 The purpose of this statement is to help PMSE users understand the pattern of interleaved spectrum after DSO and to describe how we will manage the process of migrating them to new frequencies in interleaved spectrum so that they neither cause interference to, nor suffer interference from, DTT and other uses. We are working on the basis that there should be broadly sufficient capacity in interleaved spectrum after DSO to accommodate existing PMSE use.
- 1.4 We will consult on the detailed design of the award of this spectrum as part of our Digital Dividend Review (DDR) during spring 2008.

Section 2

Digital switchover

2.1 DSO is the process of changing terrestrial television from analogue to digital technologies. In the UK, it began in Whitehaven, Cumbria, in October 2007 and will continue region by region between 2008 and 2012, following the timetable in table 1.

Table 1. Timetable for DSO¹

Region	DSO
Border	2008-09
West Country, Granada	2009
Wales	2009-10
West, STV North, STV Central	2010-11
Central, Yorkshire, Anglia	2011
Meridian, London, Tyne Tees, Ulster	2012

2.2 DSO will have three major consequences:

- there will be an expansion in the number and range of services available via terrestrial television across the UK;
- a digital dividend will become available for new uses; and
- the pattern of interleaved spectrum will change.

Impact on PMSE

2.3 Figure 1 summarises the impact of DSO on PMSE use of spectrum in Ultra High Frequency (UHF) bands IV and V.

Figure 1. PMSE use of UHF bands IV and V (channel numbers and frequencies in MHz)

Ch. 21 470-478	Ch. 22 478-486	Ch. 23 486-494	Ch. 24 494-502	Ch. 25 502-510	Ch. 26 510-518	Ch. 27 518-526	Ch. 28 526-534	Ch. 29 534-542	Ch. 30 542-550
Ch. 31 550-558	Ch. 32 558-566	Ch. 33 566-574	Ch. 34 574-582	Ch. 35 582-590	Ch. 36 590-598	Ch. 37 598-606	Ch. 38 606-614	Ch. 39 614-622	Ch. 40 622-630
Ch. 41 630-638	Ch. 42 638-646	Ch. 43 646-654	Ch. 44 654-662	Ch. 45 662-670	Ch. 46 670-678	Ch. 47 678-686	Ch. 48 686-694	Ch. 49 694-702	Ch. 50 702-710
Ch. 51 710-718	Ch. 52 718-726	Ch. 53 726-734	Ch. 54 734-742	Ch. 55 742-750	Ch. 56 750-758	Ch. 57 758-766	Ch. 58 766-774	Ch. 59 774-782	Ch. 60 782-790
Ch. 61 790-798	Ch. 62 798-806	Ch. 63 806-814	Ch. 64 814-822	Ch. 65 822-830	Ch. 66 830-838	Ch. 67 838-846	Ch. 68 846-854	Ch. 69 854-862	Ch. 70 862-870

	PMSE use subject to change after DSO
	No PMSE use after DSO
	PMSE use not affected by DSO

2.4 Channels 31 to 37, 39 to 40 and 63 to 68 will be unavailable for PMSE use after DSO as these channels will be cleared for new services, subject to auction. Channel 36 is currently used for ground based aeronautical radar, but this use will cease in 2009 leaving this channel to be auctioned alongside the cleared DDR spectrum. Channel 38 is currently mainly used for radioastronomy and is only available for PMSE use in

¹ www.digitaluk.co.uk/en/when.html.

some areas.² We have no plans to require this use to cease. Channels 69 and 70 will not be affected by DSO.

- 2.5 PMSE equipment operating in channels 21-30 or 41-62 is likely to be affected by DSO. This is because the frequencies used for DTT will change from those used for analogue terrestrial television, and so the pattern of interleaved spectrum will also change. As a consequence, PMSE users of equipment operating in interleaved spectrum are likely to find it necessary to retune, modify or replace that equipment in order to use new frequencies after DSO.

² www.ofcom.org.uk/consult/condocs/ddr/statement.

Section 3

Interleaved spectrum after digital switchover

Introduction

- 3.1 There are several potential uses of interleaved spectrum. These include:
- PMSE;
 - more DTT, including local and/or national services; and
 - two-way mobile.
- 3.2 We are working on the basis that there should be broadly sufficient capacity in interleaved spectrum after DSO to accommodate existing PMSE use. We will consult on the detailed design of the award of this spectrum as part of the DDR during spring 2008.

Access for PMSE

- 3.3 We recognise that many PMSE users want to begin planning their use of new frequencies after DSO. These plans may include retuning or modifying existing equipment or placing orders for new equipment.
- 3.4 We have therefore sought to identify interleaved spectrum that has a high probability of being available for PMSE use. As part of this assessment we have disregarded those frequencies that may be used for other services as a result of the DDR (see annex 1). We have taken this approach in order to minimise the risk that PMSE users will migrate to frequencies that are subsequently used for other services. There does, however, remain a small chance that this will happen, not least because primary users of this spectrum—DTT multiplex operators—may find it necessary to make small changes to their own use in order to optimise performance and coverage. We will endeavour to provide PMSE users with as much notice as possible of any such changes.
- 3.5 The information presented and referred to in this statement is based on the position when DSO has finished. There may be reduced availability during DSO, particularly in locations near the boundaries of main-station areas, as transmitters change frequencies one by one. We will keep PMSE users informed of any such transitional restrictions as information becomes available.

Detailed information

- 3.6 We are providing information on spectrum—both interleaved and channel 69—available for PMSE use after DSO in two different formats:
- maps; and
 - an online database.

Maps

- 3.7 We are providing maps that show spectrum availability for wireless-microphone use indoors and outdoors. A full set of these maps is available from our website at <http://www.ofcom.org.uk/consult/condocs/ddr/statement/>.

Indoor use

- 3.8 Annex 2 shows the number of channels available for indoor use. We have assumed that wireless microphones are operated in a building that attenuates incoming and outgoing radio signals by 7 dB.³ Attenuation reduces the ability of both wireless microphones to interfere with DTT reception and of DTT transmissions to interfere with wireless microphones.
- 3.9 As well as ensuring that DTT reception is protected from interference from wireless-microphone use, we also have assumed that incoming interference from DTT transmissions must be sufficiently low to allow wireless microphones to successfully operate with a receive field strength of 68 dB μ V/m.⁴ This is consistent with the recommendations of European Radiocommunications Committee (ERC) Report 88 on compatibility and sharing analysis between DVB-T and radio microphones in bands IV and V⁵ and should result in a minimum working range of approximately 90 metres.
- 3.10 Reducing this range would increase the wanted signal level at the wireless-microphone receiver and increase tolerance to interference from DTT transmissions. There may, therefore, be further channel availability at lower ranges that, although not allowed for in the map, will be indicated by the online database.

Outdoor use

- 3.11 Annex 3 shows the number of channels available for outdoor use. We have not allowed for any building attenuation.
- 3.12 We have again ensured that DTT reception is protected from interference from wireless-microphone use and assumed that incoming interference from DTT transmissions must be sufficiently low to allow wireless microphones to successfully operate with a receive field strength of 68 dB μ V/m. This is consistent with the recommendations of ERC Report 88 and should result in a minimum working range of approximately 90 metres.
- 3.13 Reducing this range would increase the wanted signal level at the wireless-microphone receiver and increase tolerance to interference from DTT transmissions. There may, therefore, be further channel availability at lower ranges that, although not allowed for in the map, will be indicated by the online database.

³ The Chester 1997 Multilateral Coordination Agreement relating to Technical Criteria, Coordination Principles and Procedures for the introduction of Terrestrial Digital Video Broadcasting (DVB-T). Table A1.9: UHF building penetration loss. www.cept.org.

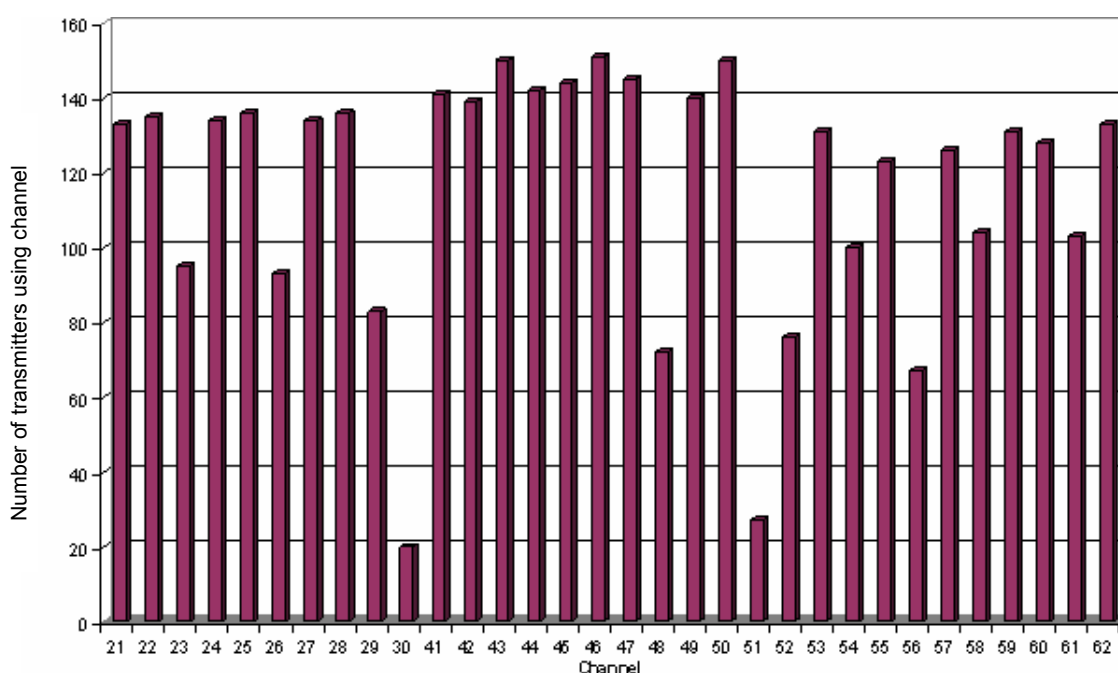
⁴ Ibid. Annex 5.

⁵ www.erodocdb.dk/docs/doc98/official/pdf/rep088.pdf.

UK-wide use

- 3.14 We recognise that channel 69 is of great importance to wireless-microphone users because it is available throughout the UK. This channel is therefore heavily used to support travelling theatre productions and musical concerts.
- 3.15 Figure 2 shows that channels 30 and 51 will generally be more available for wireless-microphone use after DSO than other channels in interleaved spectrum. This is because they are outside the nine “standard channel groups” used in the DSO plan. Channels 48, 52 and 56 are also outside those groups and so will also be less heavily used for DTT than other channels, although they are increasingly being used as a group in their own right.

Figure 2. Channel use for DTT



- 3.16 Annex 4 shows where it will be possible to use a wireless microphone in at least one of channels 28-30 and, separately, in at least one of channels 51-53. We believe that wireless microphones able to operate in these frequency ranges might prove useful to PMSE users who require coverage of much of the UK.

Online database

- 3.17 An online database, available from our PMSE licensing contractor JFMG’s website at www.jfmq.co.uk, contains detailed information on the channels in interleaved spectrum that will be available for indoor and outdoor wireless-microphone use at any given location in the UK. It uses the same data from which the maps referred to above were generated, at a resolution of 1 kilometre.
- 3.18 The database can be queried in three ways:
- by entering a six-figure National Grid Reference;
 - by entering a postcode; and

- by selecting from a list of venues.

3.19 We will ensure that any changes to spectrum availability are reflected in the database as quickly as possible.

Modelling spectrum availability

3.20 The model used to generate the information referred to above was developed by our consultants Sagentia. Its methodology was based on ERC Report 88, with three adjustments to ensure closer alignment with conditions that will apply in the UK after DSO. These are set out in table 2.

Table 2. Adjustments to ERC Report 88

Factor	ERC Report 88	Modified model	Note
DVB-T protection ratio required to protect DTT reception from harmful interference from wireless-microphone use	-3 dB	$+19.8^6 - 16^7 = +3.8$ dB	The ERC model was designed to protect DTT reception from a single wireless microphone operating in each channel. This modification protects DTT reception from any number of wireless microphones operating in each channel
Minimum median equivalent field strength for DVB-T at 10 metres above ground level 50% of the time at 50% of locations	49 dB μ V/m	53.8 ⁸ dB μ V/m	The ERC model was based on 16 QAM DTT. This modification reflects the higher field strength required for 64 QAM
Median building penetration loss	Not required	7 ⁹ dB	ERC Report 88 does not consider indoor use of wireless microphones

3.21 The model results in the separation distances set out in table 3.

Table 3. Separation distances to protect DTT fixed reception

	Indoor wireless-microphone use	Outdoor wireless-microphone use
Urban locations	0.40 km	0.65 km
Rural locations	0.90 km	1.40 km

3.22 When calculating the availability of interleaved spectrum available for wireless-microphone use, we have applied the 1.40 km protection distance. This means that availability at indoor venues and venues in urban locations can be expected to exceed what is predicted by the model.

3.23 We believe that the model is robust and broadly consistent with the spectrum-planning techniques currently employed by JFMG. Sagentia's report, including a

⁶ Memorandum of Understanding 1999, Joint Frequency Planning Project, Technical Parameters and Planning Algorithms. Table 5b: 64 QAM DVB-T co-channel protection ratio.

⁷ Ibid. Section 2.6: receiving antenna discrimination.

⁸ Ibid. Table 4: minimum median equivalent field strength required for 64 QAM DVB-T.

⁹ Chester Agreement, op. cit. Table A1.9: UHF building penetration loss.

technical description of the model, will be published on our website as soon as it is available.

3.24 DTT data were provided by National Grid Wireless, also acting as consultants to us.

3.25 Key limitations of the model are as follows:

- it is based on broadcast field-strength data used by the UK broadcasting industry to plan television networks. It predicts broadcast television signal field strength at a height of 10 metres above ground level. PMSE equipment operating above this might experience higher levels of interference; and
- it has been based on UK broadcast data and does not include the effects of possible interference from overseas broadcast networks in France, Ireland or the Benelux countries. This is consistent with the way in which JFMG currently manages PMSE spectrum use.

3.26 We are exploring the possibility of conducting field trials to validate the model. We would hope to work closely with PMSE stakeholders to ensure that the results of any such trials were of most use to them.

3.27 We will also examine the impact of overseas broadcast networks on the availability of interleaved spectrum for PMSE in the UK. If we find that this is material in areas where wireless microphones are commonly used, we will update the model accordingly.

3.28 On 21 November 2007, we published a consultation document entitled, "The future of Digital Terrestrial Television: Enabling new services for viewers."¹⁰ This examines the opportunity to upgrade the DTT platform in order to increase capacity and to pave the way for richer and more varied services, including the delivery of high-definition DTT services. We will update the model to take account of any impact of these changes on the availability of interleaved spectrum for PMSE.

¹⁰ www.ofcom.org.uk/consult/condocs/dttfuture/.

Section 4

PMSE user migration

What will we do?

- 4.1 We will write to all wireless-microphone users with a valid annual Wireless Telegraphy Act licence according to the timetable in table 4. We will provide details of the date on which DSO will begin and of the frequencies that we expect to be available for wireless-microphone use after DSO.

Table 4. Timetable for notifying PMSE licensees

Region	Latest date for notification
Border, Central, Granada, STV Central, STV North, Wales, West, West Country	29 February 2008
Anglia, Meridian, Tyne Tees, Ulster, Yorkshire	30 April 2008
London	31 October 2008

- 4.2 Information sheets will be sent to all users requesting new licences (including short-term licences) in each region from the dates given above.

What should PMSE users do now?

- 4.3 Wireless-microphone users should consult the online database to determine whether the channels that they currently use will be available after DSO.
- 4.4 If those channels are not available, wireless-microphone users should contact equipment suppliers for advice. In some cases, it may be possible to retune or modify equipment so that it will operate in new frequencies. In other cases, it may be necessary to purchase new equipment.
- 4.5 Users of other PMSE equipment (e.g. in-ear monitors and talkback systems) should contact JFMG for advice.
- 4.6 All PMSE users are advised to check the availability of spectrum with JFMG before retuning, modifying or replacing equipment.
- 4.7 PMSE users are urged to respond to the consultation on the detailed design of the award of interleaved spectrum with PMSE obligations in spring 2008.

Temporary access to channels 63 to 68

- 4.8 On 12 October 2007, we published a statement setting out our decision to allow temporary access to channels 63 to 68 for PMSE in the regions where DSO will first take place, up to the point where new users need access to the spectrum.¹¹ We understand that these channels are heavily used for PMSE and hope that this decision will help to ease the transition during DSO.

¹¹ www.ofcom.org.uk/consult/condocs/pmse/statement/statement.pdf.

Section 5

Analysis of spectrum availability

Availability of interleaved spectrum for wireless microphones after DSO

- 5.1 The PMSE sector has expressed its concern as to whether there will be sufficient spectrum available after DSO. We therefore analysed the 51 locations with the highest demand for spectrum (defined as those for which the most channels were licensed for use) in 2005. We have also assessed other locations identified as having a significant reduction in channel availability (defined as three or more).
- 5.2 Sagentia identified locations where peak demand for channels for wireless microphones before DSO exceeds the number of channels that can be expected to be available for PMSE after DSO. Figures for 2005 were used as the last year for which full demand data were available.
- 5.3 This methodology will tend to underestimate availability in indoor locations and outdoor urban locations because it was based on the availability of interleaved spectrum for outdoor use in rural locations.
- 5.4 Where we identified significant reductions in channel availability, we used licensing information from JFMG to calculate the peak use of spectrum for wireless microphones during 2005. We compared this in each location with channel availability to assess whether there are likely to be constraints after DSO. Current industry practice suggests that it is possible to use up to eight wireless microphones in a channel without difficulty.
- 5.5 Our analysis (see annex 5) suggests the following:
- in most locations of high demand, availability is expected to increase after DSO;
 - there are 11 locations where channel availability significantly reduces after DSO; and
 - two locations appear at first sight to face significant difficulties catering for existing use in the spectrum available after DSO. We comment on these below.
- 5.6 While our analysis suggests there are few areas of concern for PMSE users, we urge licensees to use the online database to assess their own individual needs.
- 5.7 In some cases, it may be possible for JFMG to license use of frequencies that are outside the model's predictions. Whether this is possible will depend on local conditions and may be subject to a site survey.

What can be done in the two locations where availability is significantly constrained compared to demand?

Towcester NN12

- 5.8 Peak demand for wireless microphones in this location was for the British Grand Prix. The model predicts that one channel will be available to satisfy peak demand for some 37 wireless microphones.

- 5.9 However, additional spectrum will be available at slightly reduced working ranges. Three channels will be available at a range of 80-90 metres, a further three at a range of 50-60 metres and a further one at a range of 30-40 metres. These will be shown by the online database and are likely to be available for use after DSO.
- 5.10 We believe it likely that a range of at least 50 metres is usable for PMSE purposes. Therefore, we think that seven channels are likely to be available, each needing to accommodate on average a little over five wireless microphones to satisfy demand for 37.

London TW17

- 5.11 Peak demand for wireless locations in this location was for film- and programme-making. The model predicts that two channels will be available to satisfy peak demand for some 24 wireless microphones.
- 5.12 Again, additional spectrum will be available at a slightly reduced working range. In this case, three channels will be available at a range of approximately 60m. These will be shown by the online database and will be available for use after DSO.
- 5.13 Therefore, we think that five channels will be available, each needing to accommodate on average a little under five wireless microphones to satisfy demand for 24.

Annex 1

Frequencies disregarded as not available for PMSE

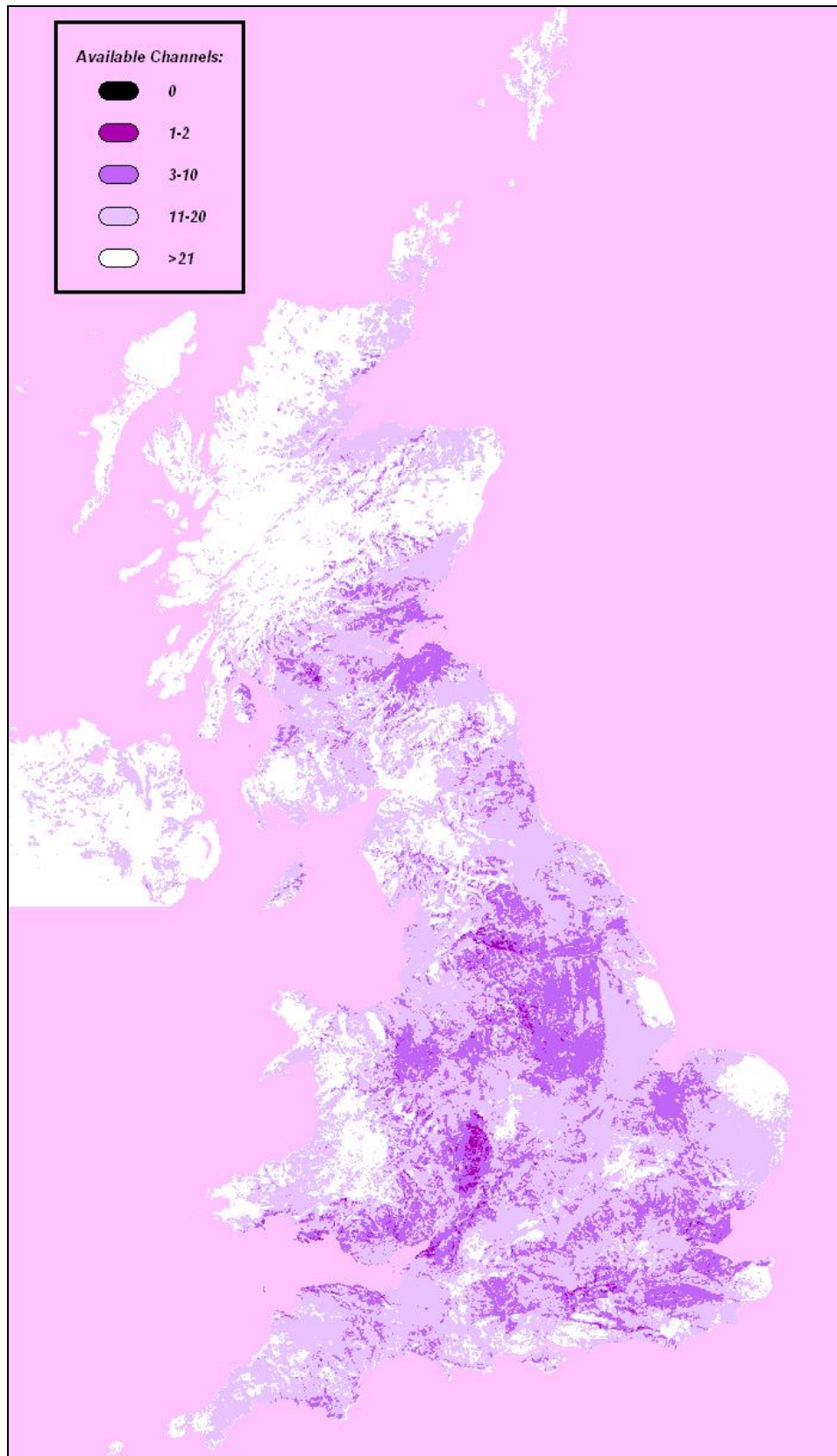
- A1.1 In seeking to identify interleaved spectrum that has a high probability of being available for PMSE, we have disregarded frequencies that may be used for other services as a result of the DDR at the locations show in table A1.
- A1.2 These frequencies have been identified as suitable for local TV assignments. As part of our consultation in Spring 2008 on the detailed design of the wider DDR award, we will be making firmer proposals as to the future plans for these frequencies.

Table A1. Locations of frequencies disregarded

Site ID	Site name	X	Y	Channel
12000	Belmont	521825	383659	21
11600	Bilsdale	455312	496220	24
10500	Black Hill	283110	664561	51
13700	Caldbeck	329951	542597	21
14700	Craigkelly	323330	687241	52
10100	Crystal Palace	533940	171220	29
10700	Divis	141190	530980	30
11300	Dover	627399	139725	57
10400	Emley Moor	422298	412887	45
12600	Hannington	452740	156807	43
13900	Heathfield	556680	122074	54
13001	Londonderry	56800	580800	48
11000	Mendip	356437	148835	55
11700	Oxford	456714	210540	49
10900	Pontop Pike	414782	552705	56
14900	Ridge Hill	363030	233363	30
10800	Rowridge	444725	86540	29
12400	Sandy Heath	520472	249446	49
11500	Sudbury	591237	237647	49
10200	Sutton Coldfield	411350	300325	51
11400	Tacolneston	613055	295727	57
12100	The Wrekin	362902	308273	48
11100	Waltham	480942	323331	55
10600	Wenvoe	311075	174160	51
10300	Winter Hill	366053	414463	56
	<i>All locations</i>			<i>61 and 62</i>

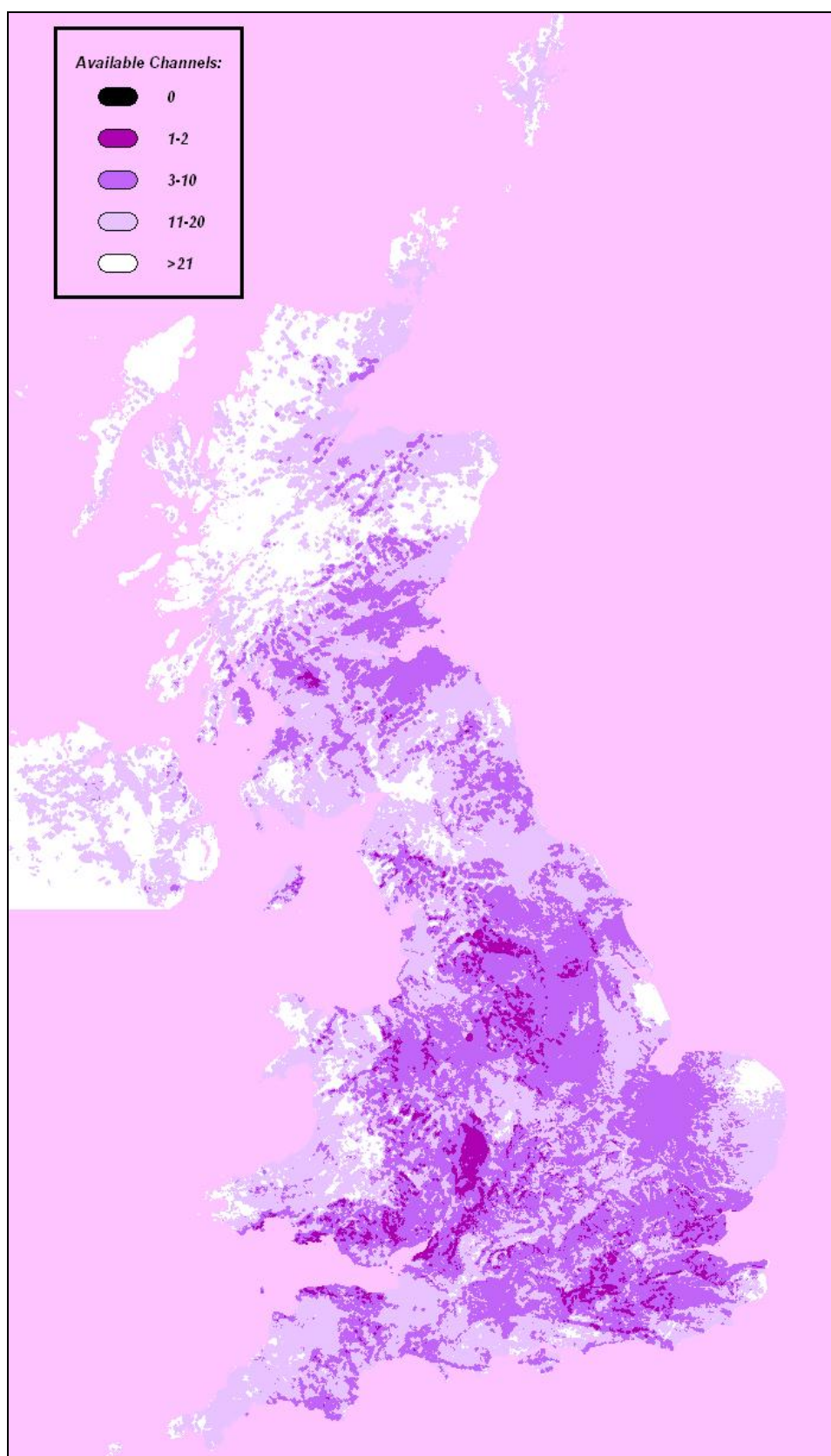
Annex 2

Spectrum availability for indoor use



Annex 3

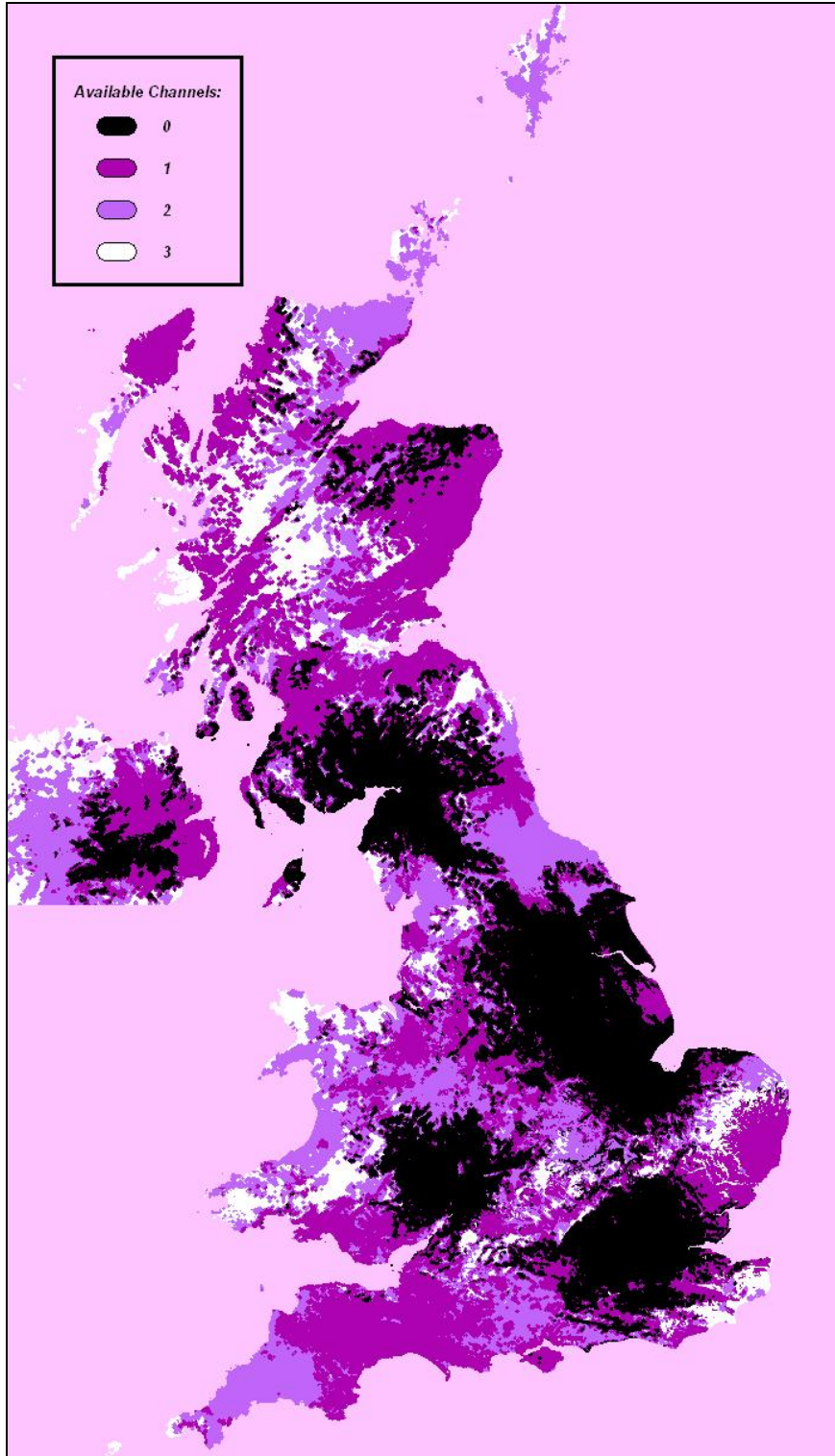
Spectrum availability for outdoor use



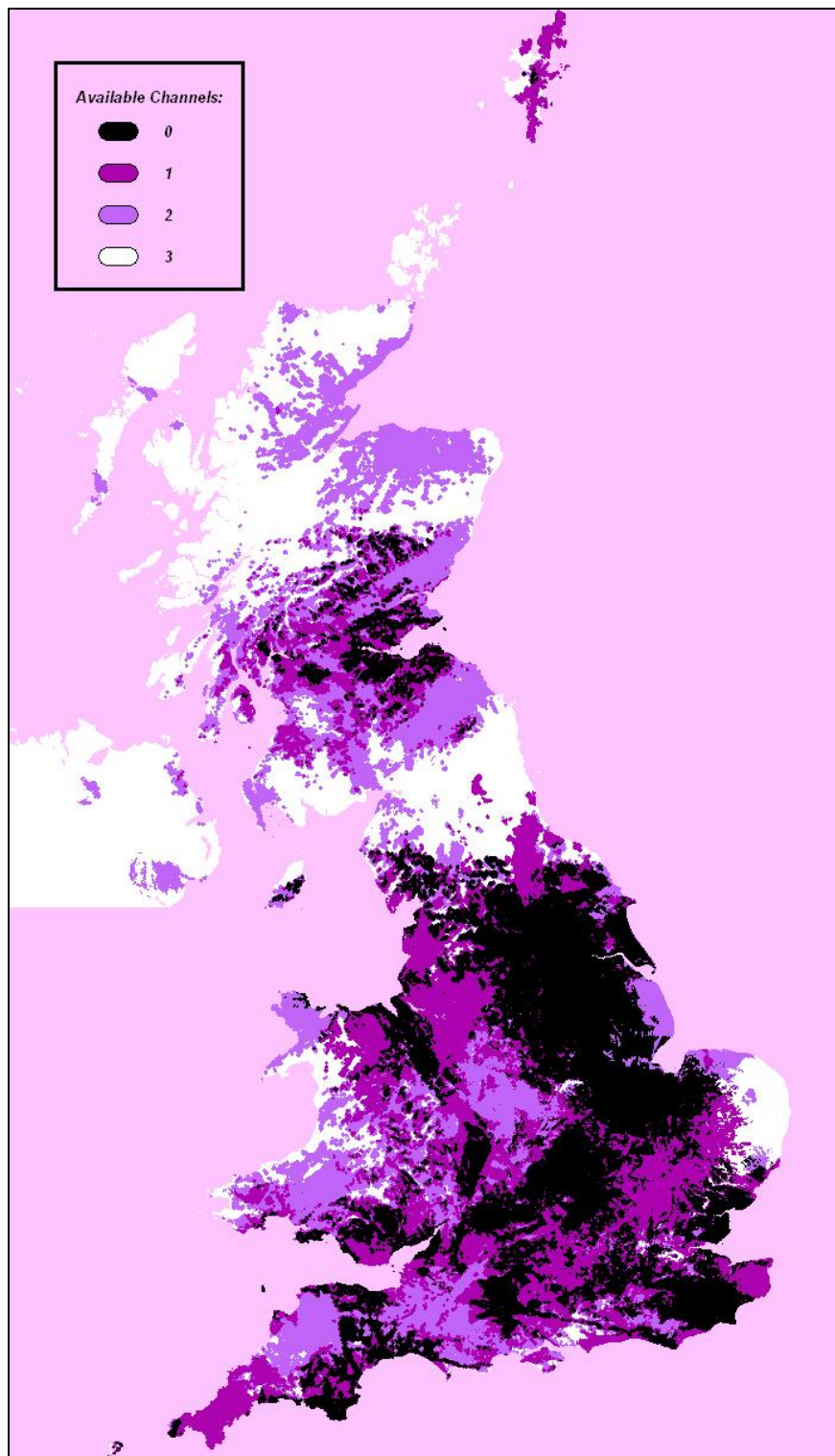
Annex 4

Availability of channels 28-30 and 51-53 for indoor and outdoor use

Availability of channels 28-30



Availability of channels 51-53



Annex 5

Results of analysis of spectrum availability

High-demand locations

A5.1 These are shown in table A2. Where channel availability reduces after DSO, we have calculated the peak use of spectrum for wireless microphones to assess whether there are likely to be constraints. We have not calculated peak use of spectrum for wireless microphones where channel availability remains constant or increases after DSO.

A5.2 For Borehamwood WD6 and London TW11, it has not been possible to determine peak demand from JFMG's licensing information because most use of wireless microphones at certain studio locations is under annually assigned licences.

Table A2. High-demand locations

Location	Channels licensed for use in 2005	Channels available after DSO	Peak microphone use in 2005	Microphones per channel after DSO
London SW1 (1)	26	24	115	4.8
London SW7	21	23	—	—
Birmingham B40	20	24	—	—
London SW5	19	22	—	—
Manchester M3	19	22	—	—
Glasgow G3	18	8	26	3.3
London EC4Y	17	19	—	—
London W12 (1)	17	19	—	—
London E16	17	19	—	—
London W1 (1)	16	24	—	—
London EC2V	16	25	—	—
Brighton BN1	15	16	—	—
London WC2R (1)	14	20	—	—
Shepton Mallet BA4	14	14	—	—
London W12 (2)	14	19	—	—
Kinross KY13	14	10	48	4.8
London TW1	14	7	17	2.4
Borehamwood WD6	14	6	Unknown	—
London W2	13	26	—	—
London SW1E	13	26	—	—
London W6	13	19	—	—
Sheffield S9	13	13	—	—
London N22	13	10	29	2.9
Cardiff CF10	12	16	—	—
Blackpool FY1	12	17	—	—
Towcester NN12	12	1	37	37.0 ¹²
London HA9 (1)	12	19	—	—
St. Andrews KY16	11	21	—	—
London WC2R (2)	11	26	—	—

¹² Other channels with shorter working ranges will be available at this location. See paragraphs 5.8 to 5.10.

Location	Channels licensed for use in 2005	Channels available after DSO	Peak microphone use in 2005	Microphones per channel after DSO
Warwick CV34	11	16	—	—
London HA9 (2)	11	21	—	—
Birmingham B1	11	15	—	—
London WC1X	10	26	—	—
London SW1 (2)	10	26	—	—
London EC3M	10	20	—	—
Belfast BT3	10	20	—	—
Bournemouth BH1	10	17	—	—
Edinburgh EH12	10	9	20	2.2
Newcastle upon Tyne NE1	10	14	—	—
Derbyshire DE74	10	5	19	3.8
London W1 (2)	9	26	—	—
Norwich NR11	9	23	—	—
Nottingham NG1	9	12	—	—
Leicester LE1	9	13	—	—
London TW11	9	8	Unknown	—
Glasgow G5	9	9	—	—
Manchester M13	9	13	—	—
London HA9 (3)	9	15	—	—
Iver SL0	9	7	35	5.0
Chelmsford CM1	9	7	23	3.3
Cheltenham GL50	9	10	—	—

Locations where channel availability significantly reduces after DSO

A5.3 Seven of these are already shown in table A2. The remaining four are shown in table A3. We have calculated the peak use of spectrum for wireless microphones to assess whether there are likely to be constraints.

A5.4 For Leeds LS3, it has not been possible to determine peak demand from JFMG's licensing information because most use of wireless microphones at certain studio locations is under annually assigned licences.

Table A3. Other locations where channel availability significantly reduces after DSO

Location	Channels licensed for use in 2005	Channels available after DSO	Peak microphone use in 2005	Microphones per channel after DSO
London UB3	7	2	9	4.5
London TW17	7	2	24	12.0 ¹³
Sunbury on Thames TW16	6	2	16	8.0
Leeds LS3	6	3	Unknown	—

¹³ Other channels with shorter working ranges will be available at this location. See paragraphs 5.11 to 5.13.

Annex 6

Glossary of abbreviations

dB	Decibel
dBμV/m	Decibel microvolts per metre
DDR	Digital Dividend Review
DSO	Digital switchover
DTT	Digital terrestrial television
DVB-T	Digital Video Broadcast—Terrestrial
ERC	European Radiocommunications Committee
PMSE	Programme-making and special events
QAM	Quadrature Amplitude Modulation
UHF	Ultra High Frequency