UHF and VHF spectrum planning

Call for inputs to Ofcom's plans for the potential procurement of models, tools & services

Call for inputs

Publication date: 26 July 2013

Closing Date for Responses: 4 October 2013

Contents

Section 1

Introduction

1.1 Like much of the radio spectrum, key frequency bands in UHF and VHF are being used ever more intensively. The switchover from analogue to digital TV; the introduction of new services such as LTE in 800 MHz; and the development of innovative new technologies like white space devices all place new demands on the spectrum. As a result there is increasing reliance on frequency planning and spectrum management information to ensure that the spectrum is used as efficiently as possible while seeking to ensure the protection of the services that use it.

1.2 As the licensing and spectrum management authority, Ofcom plays a major part in this planning and spectrum management process. We expect to continue to need tools and services which help us achieve this for the foreseeable future. As is good practice for the public sector we need to review the tools and services we use from time to time.

1.3 We also believe that information about this important national spectrum resource should be available to interested parties, in line with best practice across the public sector.

1.4 Accordingly, over the next year or so, we will be considering what tools and services are necessary to meet future requirements and the range of options open to us to ensure we can satisfy those requirements. We may need extensions to be made to the existing spectrum planning model or embark on a potential procurement of new UHF and VHF spectrum planning models, tools and services. In this call for inputs, we provide an overview of the work that Ofcom is planning to undertake regarding future spectrum planning requirements for broadcast and other services in these bands. We are seeking input from stakeholders on the following specific areas:

- The planning scenarios that we are likely to have to address over the next few years and the technologies that could be involved.
- The factors that are relevant for us to consider when assessing the impacts and benefits associated with addressing the evolution in spectrum planning requirements for DTT and DAB, and associated potential changes in requirements for a spectrum planning model.
- Requirements that other users might have from such tools.
- The outline work plan for achieving these objectives.

1.5 We are interested in comments both from users and from vendors of UHF and VHF spectrum planning models, tools and services.

1.6 For UHF and VHF spectrum planning for broadcast services in the UK, Ofcom relies upon the UK Planning Model (UKPM). The UKPM is a computer prediction tool that was first developed to provide a consistent approach (between two software implementations) to predicting the coverage of digital terrestrial television (DTT) services.

1.7 Through extensive validation and deployment during digital television switchover (DSO) and the clearance of the 800MHz band, the UKPM has shown itself to be generally accurate in predicting wide area coverage across the UK.

1.8 Since the UKPM was developed, new technologies have emerged that either share the same frequencies as DTT or are in the adjacent frequencies – examples are White Space Devices and 4G mobile broadband. As well as these new entrant technologies, there remains much work to be done in relation to broadcasting: planning for a potential digital radio switchover and a potential reorganisation of DTT broadcasting to clear the 700MHz band. It is therefore timely to review whether extensions or alternatives to this model are needed for the future.

1.9 Section 2 sets out our reasons for reviewing future broadcast spectrum planning needs. We outline a potential work plan and the expected steps for this review in Section 3.

Our relevant duties

1.10 Ofcom must act in a manner consistent with its statutory duties, including in particular its primary duty, as set out in Section 3(1) in the Communication Act 2003[1]: 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.

1.11 Ofcom has a number of other statutory duties which are also relevant to broadcast spectrum planning, including:

- securing the optimal use of spectrum[2].
- securing the wide-ranging availability of communications services and TV and radio services of high quality and wide appeal[3], and duties relating to fulfilling the purposes of public service broadcasting in the UK[4].

1.12 Ofcom is also required to have regard to the principles under which regulatory activities should be transparent, accountable, proportionate, consistent and targeted only at cases in which action is needed[5].

1.13 When carrying out functions related to the management of radio spectrum, Section 3(1) of the Wireless Telegraphy Act 2006[6] imposes a number of further duties. Ofcom is required to have regard to:

- the extent to which the electromagnetic spectrum is available for use, or further use, for wireless telegraphy;
- the demand for use of the spectrum for wireless telegraphy; and

[1] http://www.legislation.gov.uk/ukpga/2003/21/section/3
[2] Section 3(2)(a) Communications Act 2003;
[3] Section 3(2)(b) and (c) Communications Act 2003;
[4] Section 3(4)(a) Communications Act 2003;
[5] Section 3(3)(a) Communications Act 2003;
[6] http://www.legislation.gov.uk/ukpga/2006/36/section/3

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

1.14 Section 3(2) of the Wireless Telegraphy Act 2006 provides that Ofcom must also have regard to the desirability of promoting the efficient management of radio spectrum, the economic and other benefits that may arise from the use of wireless telegraphy, the development of innovative services and competition in the provision of electronic communications services.

1.15 We continue to have regard to our statutory duties in the context of broadcast spectrum planning.

Responding to this Call for Inputs

1.16 Annexes 1 to 3 set out how to respond to an Ofcom call for inputs. Annex 4 collects together the questions we have raised.

Section 2

Potential Future Requirements

2.1 This section sets out our current thinking on potential future requirements for UHF and VHF spectrum planning, and the associated impacts and benefits. We consider the reasons why UKPM was developed and the background against which it was developed. We then consider changes that have occurred since that time and thus why a review of future requirements is needed. We identify and, where possible and useful, quantify the impacts and benefits which could result from a review of potential future requirements for broadcast spectrum planning. We also want to understand how these impacts and benefits might vary depending on the approach taken.

2.2 There are several major projects for which it will be vital for both Ofcom and external stakeholders to have detailed information on the coverage achieved by and interference to DTT services, including:

- Development of white space device database(s)
- Modelling of mobile base station and hand set impact on DTT
- Developing our approach to future uses of UHF spectrum and potential future clearance of the 700 MHz band

2.3 In addition, there is a large amount of work to be done in developing plans for potential future digital radio switchover. The Ofcom broadcast radio team is already able to use a version of UKPM (licensed by the BBC) for the purposes of planning potential future digital radio switchover. Making any future broadcast spectrum planning model and/or its output available will be very important for both DTT and DAB sectors for planning the future form of each platform.

Background to development of UKPM

2.4 UKPM was originally developed for the purposes of consistently predicting the coverage that DTT services achieve across the UK. The basis of UKPM is the prediction of received field strength at a location, taking into account the environment (terrain and clutter) in between.

2.5 At the time the UKPM was developed, computer processors were not as fast and affordable as they are now. So the UKPM was limited to a 100m pixel resolution in order to produce results in a reasonable time, as performing predictions over a wide area using 100m grid resolution is computer resource intensive. For example the area for which the Crystal Palace (London) transmitter can be a significant interferer is a square with a side of about 700 km (or 490,000 square km). Assuming a 100 m grid resolution, then the field strength at 49 million points needs to be computed.

2.6 The UKPM was calibrated against field measurements and is generally accurate over a wide area for DTT predictions. For example, there were few complaints reported about the accuracy of the DTT coverage predictions during DSO. Annex 5 provides further detail on the UKPM

Evolution of requirements

2.7 The underlying algorithms and methods used in the UKPM are now more than 10 years old. Since the UKPM was first proposed in 2000, there have been:

- various developments in the UHF spectrum e.g. DSO, 800MHz clearance, 600MHz clearance and potential future 700MHz clearance;
- new users of UHF spectrum such as 4G mobile, white space devices (WSDs) and GI services;
- feasibility studies for potential future digital radio switchover.

2.8 The UKPM has served the DSO and 800MHz clearance programmes well. It was not originally designed to deal with more recent developments, such as modelling the impact on DTT coverage and reception of 4G base stations in adjacent spectrum or white space devices in interleaved spectrum. One of the consequences of modelling the impact that new technologies might have on DTT coverage would be a need to move to greater prediction resolution than currently offered by UKPM.

2.9 The ability to model DTT coverage and to carry out assessments of the impact of new-entrant technologies such as 4G and white space devices will be key to ensuring that these new technologies are able to realise their maximum potential whilst protecting the interests of DTT viewers and investors in the DTT platform. Alternative technologies would employ different network architectures and therefore different propagation models may apply.

Current Broadcast Spectrum Planning Arrangements

2.10 DTT and DAB spectrum planning is currently carried out by Arqiva, the BBC and Ofcom under joint frequency planning projects. Ofcom undertakes some DAB planning internally (using the UKPM, and ATDI ICS Telecom radio planning and modelling software), and currently contracts out most of the DTT spectrum planning work.

2.11 Ofcom's current contract for spectrum planning was awarded to Arqiva following an OJEU public procurement process. Ofcom expects to continue to have a need to contract for spectrum planning work in the future and will therefore need to re-tender this work within the next year or so. It is timely that we also review the requirements of an appropriate planning model prior to this exercise, taking into account the potential benefits of the availability of appropriate access to it in respect of potential vendors.

Basic Requirements

2.12 Our basic requirements for any future UHF and VHF spectrum planning model are that:

- it should be capable of planning frequencies and predicting coverage for digital broadcast services, on a basis that closely and consistently matches the results experienced in the real world. Accuracy, flexibility and prediction resolution are also important.

- it should be capable of assessing the effect of coexistence of other services, such as white space devices, with digital broadcast services.

- it should be accessible and available to all stakeholders. This could include access to the tool itself, the underlying parameters, the databases used, the propagation models and the outputs.

- it should be validated against measurements of DTT and DAB data such as field strength.

2.13 Annex 6 outlines in more detail the potential requirements for a new or modified broadcast spectrum planning model. This is an initial preliminary consideration of what could be required, so further thought and development will be needed in due course, including assessing which requirements are mandatory or optional.

Question 1. Do you have a specific requirement for access to a new planning model and if so, what are your specific requirements?

UHF and VHF Spectrum Planning Options

2.14 We believe that it is an opportune time to consider the future requirements for UHF and VHF spectrum planning, which could include a major review, update or development of a new broadcast spectrum planning model. Options that could be considered include:

- Continue with the existing arrangements. We note here that Ofcom will need to re-tender for DTT spectrum planning services when the existing contract expires and Ofcom will need to consider making arrangements for access to UKPM (as well as to any future UHF and VHF spectrum planning tool) to the winning tenderer;

- Consider (potentially with stakeholders) how to adapt the UKPM to increase the precision with which the impact of new services such as 4G mobile and white space devices can be modelled;

- Procure an off-the-shelf commercially available UHF and VHF planning software package, and work with the provider to customise it for Ofcom's needs. The customised model (and associated parameters, databases, outputs etc) would then need to be made available to stakeholders, and potentially be accessible via a web portal or cloud host;

- Develop an entirely new bespoke UHF and VHF planning model. This could be undertaken via a procurement process or potentially even developed in house at Ofcom. The new model would be made available to stakeholders and be potentially accessible via a web portal or cloud host (though Ofcom could not offer support if a model was developed in house).

- Alternative approaches to developing a single new model could include developing different models for different situations; or considering a range of models that trade off capability against cost and time to develop e.g. a "quick and dirty" model based on existing software that has say 70-80% of the capability of an ideal model may suffice and be just good enough given the uncertainties inherent in any statistically based prediction model.

2.15 Whatever form any new planning model takes, one important principle that is key is that the model can be made available to third parties, subject to appropriate terms and conditions.

Question 2: Have we correctly identified and characterised the potential options set out above, and what other options – if any – should be taken into account in our consideration?

Question 3: Do you have a preference for (one or more) particular options?

Impacts

2.16 Currently, the systems underpinning the UKPM are run by each of Arqiva and the BBC. There is substantial history around and complexity in making the outputs available to Ofcom and potentially to third parties.

2.17 A change in the UHF and VHF spectrum planning model (whether it is a modified UKPM, a modified off-the-shelf model, or an entirely new model) could have the following impacts:

- It may prove difficult to maintain consistency with historical UKPM coverage predictions e.g. the PSB DTT coverage target of 98.5% of UK households may not be reproduced by a new or modified model; or if it is, it may not be the same 98.5% of the UK households. However, the potential benefits of an improved "common currency" model may outweigh the issue of maintaining backward compatibility with the current UKPM.

- The development and validation of a new or modified model is likely to be a fairly lengthy process (up to two years), with no guarantee that the resulting model would improve upon the current UKPM in terms of accuracy of prediction.

- As the procurement and development process could take up to two years, we would need to continue with the existing UKPM arrangements in the interim.

- Some Ofcom stakeholders have come to rely upon the results produced by the UKPM. Adoption of any alternative or modified model is likely to involve a period during when these stakeholders would need to be made comfortable with the validity of any new or modified model.

Question 4: Have we correctly identified and characterised the potential impacts set out above, and what other impacts – if any – should be taken into account in our consideration?

Question 5: What evidence, whether qualitative or quantitative, should we obtain and/or take into account in considering each of these potential impacts? Please identify any sources of specific evidence to which we should have regard.

Benefits

2.18 The benefit of continuing the existing arrangements around DTT planning are that the UKPM is the "de facto" standard model for DTT and DAB coverage in the UK and has been proved to be generally accurate through many years of experience and backed up by measurements in the field. Another not inconsequential benefit is that the cost, time and risk of developing a new or modified model would not be incurred.

2.19 A change in the UHF and VHF spectrum planning model (whether it is a modified UKPM, a modified off-the-shelf model, or a new model) could have the following benefits:

- A new or modified model can be designed to better cope with DTT coexistence requirements, and any additional broadcast radio requirements. The model can also take account of more recent developments in algorithms and methods.

- A new or modified model should be available to whoever needs it. The wider availability may encourage the potential for innovative analysis by interested parties.

Question 6: Have we correctly identified and characterised the potential benefits set out above, and what other benefits – if any – should be taken into account in our considerations?

Question 7: What evidence, whether qualitative or quantitative, should we obtain and/or take into account in considering each of these potential benefits? Please identify any sources of specific evidence to which we should have regard.

Question 8: Should we place different weights on some impacts and benefits than on others?

Section 3

Outline Work Plan

Introduction

3.1 In this section, we outline a potential work plan and the expected steps for developing and verifying a new or modified UHF and VHF spectrum planning model.

3.2 The process set out below is one approach to obtaining a UHF and VHF spectrum planning model and should therefore be viewed as indicative only. After considering the responses to this call for inputs, Ofcom may consider alternative approaches which could speed up or slow down the timetable.

3.3 After considering the responses to this call for inputs, Ofcom may decide not to proceed with developing and/or procuring a new planning model. In this case Ofcom would continue to work with the current arrangements and would not proceed with the work plan steps beyond this call for inputs.

Work Plan

3.4 We envisage the following process:

i. Call for inputs – which is this document. Given the long-standing nature of the UKPM and the collaborative approach adopted for DTT and DAB spectrum planning through joint planning projects, it will be important for Ofcom to consult with stakeholders on the form that any future broadcast spectrum planning arrangement might take.

ii. Development of procurement strategy – consider the capabilities and range of UHF and VHF spectrum planning models and tools currently available in the market.

iii. Procurement of planning model – taking the information gathered through the call for inputs and the development of procurement strategy, we would procure (via an OJEU public procurement process) a planning model.

iv. Developing appropriate terms and conditions for third party access to any new or updated planning model or output – the aim would be to enable open access and keep any restrictions on use as limited as possible.

v. Establishment of planning model – this covers customisation or development of the model, plus potentially establishing it in Ofcom IT systems, or elsewhere (e.g. a cloud host).

vi. Verification of planning model – testing and validation of the planning model, potentially including verification against DTT and DAB field measurements.

vii. Procurement of planning service – having established the appropriate planning model and associated contractual terms and conditions, we would procure for spectrum planning services. Our initial proposal would be to seek to establish a framework agreement through which planning effort could be

called off from several pre-approved providers. This could provide Ofcom advantages in terms of cost and flexibility.

3.5 The outline timetable is as follows:

Phase	**Indicative Timetable**
Call for inputs.	July 2013
Development of procurement strategy.	July - September 2013
Procurement of new/modified planning model.	October 2013 – April 2014
Development of appropriate terms and conditions for 3rd party access.	Jan – May 2014
Establishment of planning model & software.	May – September 2014
Verification and calibration of planning model.	September 2014 – March 2015
Start of framework procurement of planning services.	March 2015

Question 9: Do you have any comments on the work plan we have outlined? e.g. do you agree with our proposed timing and approach for securing a new model?

Annex 1

Responding to this call for inputs

How to respond

A1.1 Ofcom invites written views and comments on the issues raised in this document, to be made **by 5pm on 4 October 2013**.

A1.2 Ofcom strongly prefers to receive responses using the online web form at http://stakeholders.ofcom.org.uk/consultations/uhf-vhf-spectrum-planning/ 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 andrew.chong@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.

Andrew Chong
3rd Floor
Spectrum Policy Group
Riverside House
2A Southwark Bridge Road
London SE1 9HA

A1.5 Note that we do not need a hard copy in addition to an electronic version. 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 call for inputs, or need advice on the appropriate form of response, please contact Andrew Chong on 020 7783 4320 or email to andrew.chong@ofcom.org.uk.

Confidentiality

A1.8 We believe it is important for everyone interested in an issue to see the views expressed by 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, can you please specify what part or whether all of your response should be kept confidential, and specify why. Please also place such parts in a separate annex.

A1.9 If someone asks us to keep part or all of a response confidential, we will treat this request seriously and 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/disclaimer/

Next steps

A1.11 Following the end of the period for inputs, Ofcom may publish a statement in early 2014.

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 or call for inputs is as easy as possible. For more information please see our consultation principles in Annex 2.

A1.14 If you have any comments or suggestions on how 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 Graham Howell, Secretary to the Corporation, who is Ofcom's consultation champion:

Graham Howell
Ofcom
Riverside House
2a Southwark Bridge Road
London SE1 9HA

Tel: 020 7981 3601

Email Graham.Howell@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

Response cover sheet

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

A3.2 We have produced a 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: UHF and VHF Spectrum Planning

To (Ofcom contact): Andrew Chong

Name of respondent:

Representing (self or organisation/s):

Address (if not received by email):

CONFIDENTIALITY

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

Nothing ☐ Name/contact details/job title ☐

Whole response ☐ Organisation ☐

Part of the response ☐ If there is no separate annex, which parts?

If you want part of your response, your name or your organisation not to be published, can 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

Questions in this call for inputs

A4.1 This call for inputs has identified the following key questions. Respondents are also welcome to raise other issues on which they would like to comment.

Question 1: Do you have a specific requirement for access to a new planning model and if so, what are your specific requirements?

Question 2: Have we correctly identified and characterised the potential options set out above, and what other options – if any – should be taken into account in our consideration?

Question 3: Do you have a preference for (one or more) particular options?

Question 4: Have we correctly identified and characterised the potential impacts set out above, and what other impacts – if any – should be taken into account in our consideration?

Question 5: What evidence, whether qualitative or quantitative, should we obtain and/or take into account in considering each of these potential impacts? Please identify any sources of specific evidence to which we should have regard.

Question 6: Have we correctly identified and characterised the potential benefits set out above, and what other benefits – if any – should be taken into account in our assessment?

Question 7: What evidence, whether qualitative or quantitative, should we obtain and/or take into account in assessing each of these potential benefits? Please identify any sources of specific evidence to which we should have regard.

Question 8: Should we place different weights on some impacts and benefits than on others?

Question 9: Do you have any comments on the work plan we have outlined? e.g. do you agree with our proposed timing and approach for securing a new model?

Annex 5

UK Planning Model

Introduction

A5.1 This annex provides a high level summary of the current arrangements relied on by Ofcom for UHF and VHF spectrum planning of broadcast services using the UK planning model (UKPM).

A5.2 Ofcom currently uses the UKPM for DTT and some DAB spectrum planning in the UK. It was originally developed for the purposes of consistently predicting the coverage that DTT services achieve across the UK; and then expanded to include DAB.

Development of UKPM

A5.3 UKPM was jointly developed (during 2000 to 2002) by the BBC, the Independent Television Commission (one of the legacy regulators whose functions were transferred to Ofcom), and Arqiva (formerly NTL and Crown Castle). The main purposes of developing the UKPM were:

- to produce consistent prediction results between the UK DTT planning organisations (particularly important as the UK was at the time commencing planning for how a potential switchover to digital TV might occur).
- to take advantage of the availability of the high resolution terrain and clutter data and relative improvements in computer processing power at the time.

A5.4 The UKPM's basis was to model the physical propagation of radio-frequency waves. It used fast, reliable and reproducible processes to plan and predict DTT coverage. The BBC published a white paper[7] that describes the UKPM and its technical development.

A5.5 During 2009 to 2011, the UKPM was extended to allow DAB spectrum planning, in addition to DTT in anticipation of the need to carry out consistent coverage planning with which to inform the Government's thinking on a potential digital switchover for radio.

Use of UKPM

A5.6 The UKPM was used (under commission by Ofcom) to carry out the DTT spectrum planning for digital TV switch over[8] (DSO) and 800MHz clearance[9], including:

- Coverage predictions on a UK, nations, regions and individual DTT station basis. The UKPM predicts that the three PSB (Public Service Broadcasting) multiplexes cover 98.5% of UK households, whilst the three commercial multiplexes cover around 89% of UK households.

[7] http://downloads.bbc.co.uk/rd/pubs/whp/whp-pdf-files/WHP048.pdf
[8] http://media.ofcom.org.uk/2012/10/24/end-of-an-analogue-era-paves-way-for-4g-mobile/
[9] http://stakeholders.ofcom.org.uk/spectrum/clearance-coexistence/800-MHz-DTT-Clearance/

- Interference predictions to UK and European DTT stations, as part of international coordination negotiations to achieve bilateral agreement with our European neighbours on DTT spectrum plans.

- Roll out and transition planning to minimise disruption to households during the phased roll out of DSO infrastructure works associated with the four year transition from analogue TV to DTT.

- Mitigation of coverage losses via UHF channel changes, power increases, and antenna pattern improvements at existing DTT stations, plus the frequency planning of new DTT relay stations.

A5.7 The UKPM has also been used to plan other DTT services including local TV[10], geographic interleaved (GI) multiplexes[11], the Northern Ireland multiplex[12] (carrying TG4 and RTE services) and 600MHz multiplexes[13]. The planning process involves looking for available UHF channels that can provide the coverage required whilst still protecting the national PSB and commercial multiplexes from unacceptable interference.

A5.8 The UKPM is currently being used for investigating various DTT band plan scenarios for potential future 700MHz clearance[14].

A5.9 Whilst the UKPM was initially developed for DTT, it has recently been adapted for DAB planning[15] by the BBC, Arqiva and Ofcom for use in the joint frequency planning work for potential future digital radio switchover. Again, one of the main reasons for using the UKPM for DAB planning was to achieve consistency between the planning organisations.

A5.10 However, the actual implementation of the UKPM processes does vary between the organisations due to factors such as operating platform and program coding. As a result predictions and coverage figures produced for the same set of wanted and interfering transmitter parameters by different organisations can be expected to exhibit small variations.

A5.11 As can be seen from the many footnote references to Ofcom consultations, statements and licence awards, the UKPM is an important tool and produces major outputs for broadcast spectrum planning. There are several major projects for which it will be vital for both Ofcom and external stakeholders to have detailed information on the coverage achieved by and interference to DTT services, including:

- Development of white space device database(s)
- Modelling of mobile base station and hand set impact on DTT
- Developing our approach to future uses of UHF spectrum and potential future clearance of the 700 MHz band

[10] http://licensing.ofcom.org.uk/tv-broadcast-licences/local/
[11] Cardiff GI and Manchester GI
[12] http://consumers.ofcom.org.uk/files/2012/07/NIMuxFactsheet4.pdf
[13] http://stakeholders.ofcom.org.uk/spectrum/spectrum-awards/awards-in-progress/600mhz/
[14] http://stakeholders.ofcom.org.uk/consultations/700mhz-cfi/
[15] http://stakeholders.ofcom.org.uk/binaries/broadcast/radio-ops/coverage/Annex_E.pdf

A5.12 In addition, there is a large amount of work to be done in developing plans for potential future digital radio switchover. The Ofcom broadcast radio team is already able to use a version of UKPM (licensed by the BBC) for the purposes of planning potential future digital radio switchover. Making any future broadcast spectrum planning model and/or its output available will be very important for both DTT and DAB sectors for planning the future form of each platform.

Annex 6

Potential Specifications

A6.1 Ofcom is considering a UHF and VHF network planning model for DTT, Eureka 147 DAB technologies and FM services in the UK, which should also be capable of modelling the impact of mobile technologies and other services on broadcast services. The model should be available to third parties on appropriate terms and conditions. The model should meet the following specifications (though Ofcom has yet to decide which are mandatory and which are optional).

A6.2 The following sections outline what is needed by Ofcom for such a model.

Propagation Model

A6.3 Any such planning model should support recent, state of art propagation models covering the frequency ranges from 50 MHz to 6 GHz and in particular, suitable for broadcast and mobile technologies.

A6.4 The tool should support propagation model comparison and tuning functionality to demonstrate accuracy and calibration with field strength measurements. Ofcom may make available some historical UK field strength measurements.

A6.5 As a minimum, the model should support both time (e.g. 1%, 5% & 50%) and coverage (signal\field strength) reliabilities.

A6.6 The inclusion of standard propagation models such as ITU Rec. 1546, Rec. 1812, Hata etc would be also useful, plus the ability to add new standard models in future.

Coverage

A6.7 The planning tool should be capable of calculating the coverage of one or more DTT and DAB transmitter stations, up to and including the entire UK network of around 1160 DTT or 1000 DAB stations, taking into account the interference from 3000+ European transmitter stations. The tool should be capable of modelling both multi-frequency networks and single frequency networks.

A6.8 In addition to individual multiplex coverage, the overlap “core” coverage of two or more multiplexes is required, up to a maximum overlap of ten multiplexes e.g. the 3PSB core coverage is where all three PSB DTT multiplexes are available.

A6.9 Coverage should be predicted for the UK as a whole, the individual nations, defined regions (e.g. ITV regions or parliamentary constituencies) and individual stations or licensed areas.

A6.10 The tool should be able to employ geographical data at any available resolution and produce coverage at any desired accuracy (e.g. 5m, 50m, 100m etc)

A6.11 The area coverage threshold should be definable by field/signal strength and percentage locations.

A6.12 Population coverage should be calculated by cut off and proportional methods.

A6.13 Coverage to fixed roof top (wideband and grouped), portable indoor set top aerials and, in the case of DAB, mobile (vehicle) aerials should be accommodated by the planning tool. In the case of portable set top aerials, the height and building losses should be adjustable.

Digital Preferred Service Areas

A6.14 In cases where more than one DTT transmitter is available in a pixel, there are various methods for deciding which is the preferred service for that pixel e.g. is it the best service, the correct regional service etc. Thus digital preferred service areas (DPSAs[16]) allocate pixels and thus coverage to certain DTT transmitters. The planning tool or its output should enable calculation of DPSA coverages. In addition to best server, the tool should support Nth best server where $N \leq 5$.

Intra and Inter Technology Interference Analysis

A6.15 DTT to DTT and DAB to DAB co-channel and adjacent channel interference analysis is a requirement. With regards to signal combination, a range of combinations methods would be useful, including Schwartz and Yeh[17].

A6.16 Other services to DTT and DAB co-existence analysis is also a requirement. Other services may include adjacent 4G base stations or user equipment and co-channel PMSE, PMR or White Space Devices.

A6.17 Protection ratios and receiver characteristics (such as receiver noise, masks, filters etc) should be adjustable.

Receive Aerial

A6.18 The receive aerial model should be adjustable in terms of directivity (radiation pattern), front to back ratio, cross polar discrimination and gain versus UHF channel response.

Technology

A6.19 The planning tool should support Eureka 147 DAB technologies, FM, DVB-T and DVB-T2 in addition to mobile technologies such as LTE.

Database

A6.20 The terrain and clutter databases should cover the UK (including Northern Ireland), Isle of Man and Channel Islands. Terrain and clutter databases for Belgium, France, Ireland, and the Netherlands (whose DAB and DTT stations will be the main interferers to the UK) should also be included, though a lower resolution than the UK is acceptable. The ITU IDWM terrain database is required for coordination purposes.

---

[16] http://stakeholders.ofcom.org.uk/binaries/consultations/ddr/statement/ngw1c.pdf

[17] Schwartz, S.C. and Yeh, Y.S., 1982, "On the distribution function and moments of power sums with log-normal components", Bell Systems Technical Journal, September 1982. http://www.alcatel-lucent.com/bstj/vol61-1982/articles/bstj61-7-1441.pdf

A6.21 The population database, in terms of households and people, should cover the UK (including Northern Ireland) and Isle of Man, and if possible, the Channel Islands also. The tool should be able to import and perform statistical analysis over population database, in terms of households and people.

A6.22 The planning tool should be capable of importing transmitter and antenna database information; including the CEPT TVD file format and the UKPM TVD and PLT file formats (a link or annex for the file format specifications will be provided). Import and export of the ITU SGML files and the BRIFIC would also be useful. The receive aerial model specified in ITU-R Recommendation 419-3 should be included as a standard

Export Formats

A6.23 Overlay maps should be exportable to MapInfo and Google Earth.

A6.24 Coverage data should be exportable to Excel or CSV format; and must include as a minimum percentage locations, field strengths and population counts.

A6.25 Options for GE06 filing and conformity checks would be useful functions, including calculation to test point files.

Relationship with UKPM predictions

A6.26 Ofcom would need to understand how any new planning tool results relate to UKPM predictions. In particular, the coverage target for the PSB DTT multiplexes of 98.5% of UK households is maintained by UKPM predictions, but would any new planning tool give the same prediction? If not, what are the reasons? If yes, is it same 98.5% of households? How consistent could the new planning tool be with the UKPM?

A6.27 The tool should be able to import UKPM coverage predictions to perform comparison, calibration and validity of new predictions with UKPM.

Computer Resources

A6.28 The planning tool should be capable of carrying out predictions nationwide (e.g. 1200 DTT station network plus 3000 interferers) in a reasonable time (e.g. no more than a few hours) with reasonable computer resources. The capability to run the planning tool using cloud computing resources would also be useful.

Accessibility & Availability

A6.29 A specified number of Ofcom users will need access to the planning tool, with concurrent use by up to a specified number of users. Remote access, and batch and background runs would also be useful.

A6.30 The planning tool should be available to other organisations, who may wish to replicate or supplement Ofcom's prediction work using the same planning tool for their own purposes.

Support & SLAs

A6.31 Ofcom would expect to include provision for support and options for service levels. It would be helpful at this stage to understand what arrangements for support and SLAs apply to other modelling tools.

Annex 7

Glossary

4G – the fourth generation of mobile communications technology standards, including LTE. See http://consumers.ofcom.org.uk/4g/ for more information.

DAB – Digital Audio Broadcasting
DAB is a digital radio standard used in UK and Europe.

DSO – Digital TV Switch Over

DTT - Digital Terrestrial Television
Any form of terrestrial television broadcasting delivered by digital means. In the UK and Europe, DTT transmissions use the international DVB-T and DVB-T2 technical standards.

DVB-T2
An advanced digital terrestrial transmission technology developed by DVB (Digital Video Broadcasting). DVB-T2 technology is more efficient than the original DVB-T standard, and is used to deliver high definition TV services on DTT in the UK.

Eureka 147
The Eureka 147 consortium was part of EUREKA - an intergovernmental initiative supporting European innovation starting in 1985. A technical body under the name of Eureka 147 Consortium initiated the original DAB (Digital Audio Broadcasting) System.

GI spectrum – Geographic Interleaved spectrum
The geographic interleaved spectrum is so called because it can be used at a local level on a shared – or interleaved – basis with DTT.

LTE – Long Term Evolution
LTE is a 4G standard for wireless communication of high-speed data for mobile phones and data terminals.

MHz - Megahertz.
A unit of frequency of one million cycles per second.

Multiplex
In digital TV broadcasting, a single physical layer signal which contains, when decoded, multiple discrete streams of digital information (including video and audio streams). Individual components of the multiplex are decoded at the receiver in order to present the desired TV service to the viewer.

PSB - Public Service Broadcasting or Public Service Broadcaster.

UHF - Ultra-High Frequency
The frequency range from 300 MHz to 3000 MHz. Terrestrial TV broadcasting in the UK uses UHF frequencies between 470 MHz and 790 MHz.

UKPM – UK Planning Model
The current planning model used for DTT and DAB in the UK.

VHF Band III
The frequency range from 174 to 230 MHz used for Terrestrial Broadcasting and, in the UK, Private Mobile Radio.

WSD - White Space Device(s)
Radio devices which make use of transmission frequencies that are nominally allocated to other services but which are unused in the vicinity of the device.