



# Future use of the 700MHz band

Implementing Ofcom's UHF strategy

Call for inputs

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## Section 1

# Introduction

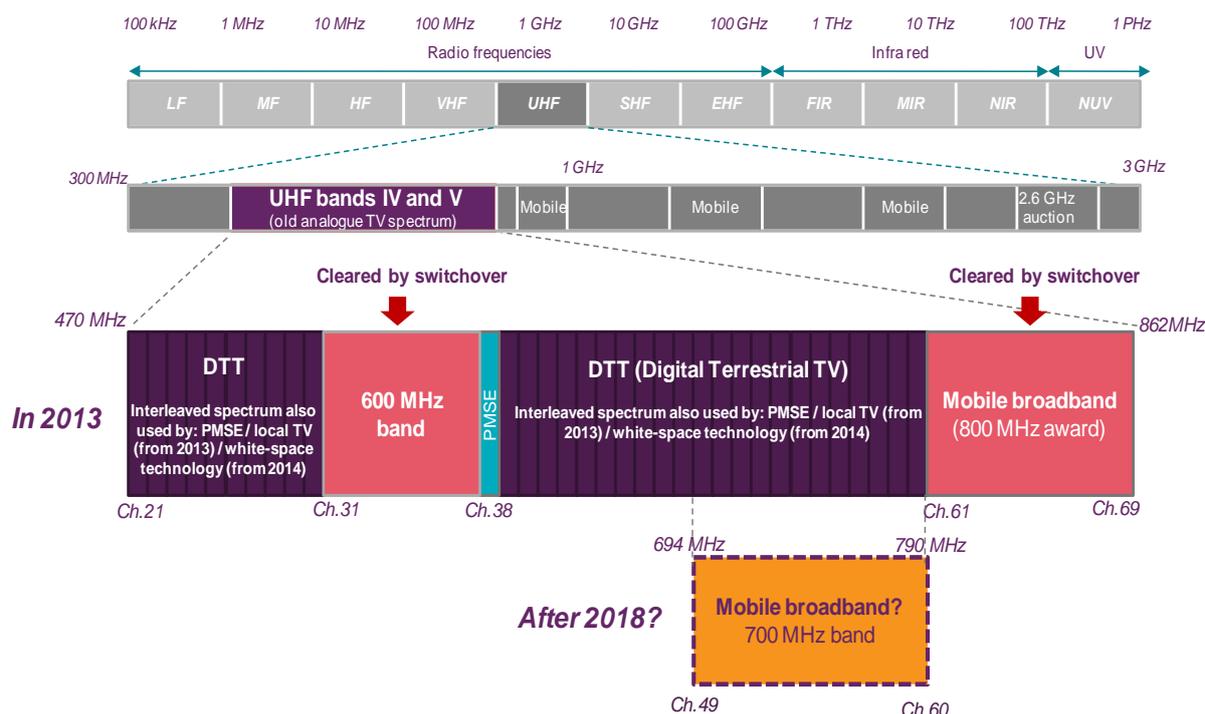
## Our UHF Strategy

- 1.1 Ofcom's UHF Strategy Statement, published in November 2012, set out two objectives relating to the use of UHF bands IV and V<sup>1</sup>, which cover the frequency range 470-862 MHz, namely:
- enabling the release of additional low frequency spectrum for mobile broadband use, to help meet the rapidly increasing demand for mobile data capacity; and
  - securing the ongoing delivery of the benefits provided by Digital Terrestrial Television (DTT).
- 1.2 We said that to achieve these objectives we would support the international process and conduct preparatory work to enable the harmonised release of the 700 MHz band. We also said that we would seek to ensure that the 600 MHz band can be used for DTT and other services sharing spectrum with it on a geographic interleaved basis, assuming harmonised release of the 700 MHz band for mobile broadband takes place. We have now started a programme of work to prepare for implementation of our UHF strategy.
- 1.3 The 700 MHz band is currently used for DTT, and other services sharing spectrum with it, including Programme Making and Special Events services (PMSE). In the near future this spectrum is also expected to be used for Local TV and new applications based on white-space technology.
- 1.4 Any change of use of the 700 MHz band from broadcasting to mobile broadband services would need to be coordinated at an international level. Consequently, international developments will influence many aspects of the future of the 700 MHz band, including potentially the future use of the band, the timing of any release and the exact DTT band plan adopted by the UK. The need for new international agreements makes it likely that none of these changes will take place until 2018 at the earliest.
- 1.5 We note that, at this stage, no final decisions have been taken at an international, EU or UK level that the 700 MHz band will be released for use for mobile broadband services. Our work to enable the harmonised release of this spectrum remains subject to, in particular, the international developments discussed in more detail in Section 3 and other factors, such as the expected continued increase in demand for mobile data services. Whilst Ofcom will be an active participant in the international processes, we cannot be sure of the outcomes at this point in time. We will continue to monitor and review developments in these areas as the work progresses.
- 1.6 When we refer to the 700 MHz band in this document, we mean the frequency range 694-790 MHz. Figure 1 below, which is reproduced from the UHF Strategy Statement displays the location of this spectrum alongside other spectrum in UHF bands IV and V.

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<sup>1</sup> Ofcom, 16 November 2012, "Securing long term benefits from scarce low frequency spectrum: UHF strategy statement", (hereinafter "UHF Strategy statement") available at [http://stakeholders.ofcom.org.uk/binaries/consultations/uhf-strategy/statement/UHF\\_statement.pdf](http://stakeholders.ofcom.org.uk/binaries/consultations/uhf-strategy/statement/UHF_statement.pdf)

**Figure 1: UHF bands IV and V and the 700MHz band**



## Purpose of this call for inputs

1.7 In this document we provide an overview of the work that Ofcom is planning to undertake regarding the future of the 700 MHz band. We are also seeking input from stakeholders on two specific areas:

- The factors that are relevant for us to consider when assessing the costs and benefits associated with a potential future change of use of the 700 MHz band. We are also seeking to explore whether market mechanisms, such as an incentive auction, could have a role to play in determining the timing of a future release of the 700 MHz band.
- The measures that we can and should take, ahead of any future change of use of the 700 MHz band, to reduce the disruption and costs which could result from a change of use of the band.

1.8 Section 2 outlines the areas of work we are planning to take forward to implement our UHF Strategy and the next steps. Section 3 considers our international engagement in relation to a potential future release of the 700 MHz band. The specific questions we are seeking input on in this call for inputs are set out in more detail in Section 4 (on understanding the costs and benefits of a potential future release of the 700 MHz band) and Section 5 (on reducing impact of a potential change of use of the 700 MHz band). It should be noted that, at this stage, we are not specifically asking for input on the detailed mobile band planning work through this call for input.

## Our relevant duties

1.9 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: 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.

- 1.10 Ofcom has a number of other statutory duties which are also relevant to the implementation of our UHF strategy, including:
- securing the optimal use of spectrum<sup>2</sup>;
  - securing the wide-ranging availability of communications services and TV and radio services of high quality and wide appeal<sup>3</sup>, and duties relating to fulfilling the purposes of public service broadcasting in the UK<sup>4</sup>; and
  - promoting competition, encouraging investment and innovation and encouraging the availability and use of high speed data transfer services throughout the United Kingdom<sup>5</sup>.
- 1.11 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<sup>6</sup>.
- 1.12 When carrying out functions related to the management of radio spectrum, Section 3(1) of the Wireless Telegraphy Act 2006 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
  - the demand that is likely to arise in future for the use of spectrum for wireless telegraphy.
- 1.13 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.
- 1.14 In addition, general duties derived from the European regulatory framework are of relevance. These include the objective of 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 and encouraging the interoperability of pan-European services<sup>7</sup>.
- 1.15 We continue to have regard to our statutory duties in the context of implementing our UHF strategy.

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<sup>2</sup> Section 3(2)(a) Communications Act 2003

<sup>3</sup> Section 3(2)(b) and (c) Communications Act 2003

<sup>4</sup> Section 3(4)(a) Communications Act 2003

<sup>5</sup> Section 3(4)(b), (d) and (e) Communications Act 2003

<sup>6</sup> Section 3(3)(a) Communications Act 2003

<sup>7</sup> Article 8 of Directive 2002/21/EC of the European Union and of the Council of 7 March 2002 on a common regulatory framework for electronic communications networks and services (Framework Directive)

## Section 2

# Preparing for implementation

## Introduction

- 2.1 As explained in the UHF Strategy Statement, we would expect a release of the 700 MHz band to create significant benefits for citizens and consumers. However there may also be some disruption for consumers if a change of use of the band takes place.
- 2.2 In pursuing the objectives we have set out, we will have regard to the interests of all affected stakeholders. However, in line with our primary duty, we will have particular regard to furthering the interests of citizens and consumers, in considering both the alternative uses of the spectrum, and the disruption associated with any change of use.

## Overview of workplan

- 2.3 We said in the UHF Strategy Statement that to achieve our dual objectives of providing more low frequency spectrum for mobile broadband, whilst also securing the ongoing delivery of benefits provided by DTT, we would:
- support the international process and conduct preparatory work to enable the harmonised release of the 700 MHz band; and
  - seek to ensure that the DTT platform can access the 600MHz band (550-606 MHz) assuming change of use at 700 MHz takes place<sup>8</sup>. This approach would also help secure the ongoing delivery of other services sharing spectrum with DTT, such as PMSE and potential new services based on white space technology.
- 2.4 The key strands of work we have identified to prepare for the implementation of the above strategy are:
- Engaging in the various international forums with a view to securing an outcome that best serves the interests of UK citizens and consumers. We discuss our work in this area further in Section 3.
  - Undertaking an initial cost-benefit analysis to build on our position in the UHF Strategy Statement and inform other implementation decisions. We are also initiating work to identify the options for determining the timing of any release that maximises the benefits for citizens and consumers. We are seeking views from stakeholders on this through this call for inputs (see Section 4).
  - Exploring opportunities for reducing, and potentially avoiding, costs and disruption, such as those related to the need to modify or bring forward the replacement of consumer equipment, as a result of a change in use of the 700

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<sup>8</sup> Ofcom has recently consulted on the award of the 600 MHz spectrum band – Ofcom, 6 Feb 2013, “Award of the 600 MHz spectrum band Including request to stakeholders to notify intention to apply”, available at <http://stakeholders.ofcom.org.uk/binaries/consultations/600mhz-award/summary/condoc.pdf> . We are now reviewing the received responses and will publish a statement on how we intend to award the spectrum as soon as possible

MHz band. We are seeking views from stakeholders on this through this call for inputs (see Section 5).

- Should a decision be taken to change the use of the 700 MHz band then there will be a range of issues about how in practice this will be implemented. In advance of a decision Ofcom will begin consideration of implementation issues and will engage with Government as appropriate. Such issues include:
  - the regulatory steps that would need to be taken for current users to cease using the 700 MHz band and for those services (primarily DTT and PMSE) to be given access, as appropriate, to frequencies in the spectrum remaining for that use, including the 600 MHz band;
  - the approach to implementing any necessary changes to DTT transmission infrastructure, including roll-out planning;
  - where the costs incurred in a transition process could fall and how those costs might be met, including whether any mitigating action would be required and how that could be managed; and
  - the scope and structure of a potential future award of the 700 MHz band, including (in due course and if appropriate) auction design.

## Next steps

- 2.5 Taken together, the activities outlined above will help ensure that, in so far as possible and consistent with our UHF Strategy, any decisions regarding the future use of the 700 MHz band are made with regard to maximising the benefits to citizens and consumers.
- 2.6 We have started work in all of the above areas and respondents are welcome to comment on all aspects of our approach to this work. At this stage, we are in particular asking for input on our approach to the cost-benefit analysis; our approach to determining timing of any release of the band; and on the pre-emptive work that can be done now to reduce or avoid disruption and costs that could result from a change of use of the band. The questions in this document therefore focus on these areas.
- 2.7 Given the important international dimension to issues such as spectrum harmonisation and band planning, decisions regarding release of the band will need to take the international context into consideration. The nature of and timing of any final decisions in the UK regarding the future of the 700 MHz band are therefore to some extent dependent on developments at an international level (and the timing of those developments). The matters addressed in this document take this context into account.
- 2.8 Over the coming months we will continue to engage in the international arena and to analyse implementation policy options. In parallel to this, we plan to initiate a number of studies aimed at helping us develop a better understanding of the magnitude of the costs and benefits of a potential release of the band. Examples include an audit of what aeriels are currently in use by households to watch DTT and a study into how DTT transmission infrastructure would need to be modified if the 700 MHz band were to be released. We will also be engaging with industry on potential pre-emptive steps that could be taken to help reduce any costs and disruption resulting from a potential change of use of the 700 MHz band.

- 2.9 Following closure of this call for input on 5 July 2013 we will review responses and take them into account in our further work. We plan to communicate further about this work, including the cost-benefit analysis and on our thinking on implementation policy, by early 2014.

## Section 3

# International engagement

## Introduction

- 3.1 There is an important international dimension to a potential change of use of the 700 MHz band. We will need international agreements both in relation to the future use of the 700 MHz band, if it is to be used for mobile broadband, and in order to re-plan the use of the spectrum which would remain in use for DTT and other services sharing the DTT spectrum.
- 3.2 International agreements are required when deploying or re-planning high power services, such as broadcasting, to avoid interference across national borders. They also help maximise the benefits to UK citizens and consumers because harmonisation of spectrum use across borders generally increases economies of scale, widening the availability of consumer equipment and reducing prices.

## Future use of the 700 MHz band

- 3.3 At present, there are two parallel but interrelated international activities on-going relating to the potential future use of the 700 MHz band:
- the first relates to preparation for the next World Radiocommunication Conference (WRC) of the International Telecommunication Union (ITU) in 2015; and
  - the second relates to a mandate from the European Commission to the European Conference of Postal and Telecommunications Administrations (CEPT).
- 3.4 The last WRC in 2012 allocated the 700 MHz band for mobile services on a co-primary basis with broadcasting. It is intended that this allocation will come into effect immediately after the next WRC in 2015 (WRC-15), subject to a number of technical studies. This means that when that decision has been confirmed, the mobile service and the broadcasting service will have equal status in the 700 MHz band making future authorisations for mobile use easier and more attractive. There are a number of key international decisions relevant to the co-primary allocation which remain outstanding and will be confirmed at WRC-15 under its agenda item 1.2, including:
- confirming the decision on co-primary allocation;
  - defining the lower band edge; and
  - agreeing the mobile band plan.
- 3.5 In March this year the European Commission issued a mandate<sup>9</sup> to CEPT to develop a set of common minimal and least restrictive technical conditions for use of the

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<sup>9</sup> European Commission, Radio Spectrum Committee, working document RSCOM12-37rev3, 20 Feb 2013, "Mandate to CEPT to develop harmonised technical conditions for the 694-790 MHz ('700 MHz') frequency band in the EU for the provision of wireless broadband electronic communications services and other uses in support of EU spectrum policy priorities, available at <https://circabc.europa.eu/d/d/workspace/SpacesStore/6eda88bf-ed1a-4af4-bb26->

700 MHz band by mobile broadband applications. The mandate states that these conditions should be sufficient to allow EU member states to deploy mobile broadband services in the 700 MHz band. Our current expectation is that the CEPT response to the Commission mandate will form the basis of a binding Commission Decision on the technical conditions for mobile broadband use of the 700 MHz band, but that the Commission Decision would not oblige EU Member States to make the 700 MHz band available for mobile broadband use. The mandate foresees two deliverables: the first is a report by the end of 2014 with a preliminary set of technical conditions; and the second, in 2016, is a report with the final technical conditions accounting for any changes needed as a consequence of the WRC-15 outcome.

### **Confirming co-primary allocation and defining the band edge**

- 3.6 The allocation for mobile use, on a co-primary basis with broadcasting, does not guarantee the band will be used for this service but it is a significant enabler. If there is no binding harmonisation measure, countries have the flexibility to decide whether to continue using the 700 MHz band for broadcasting or to introduce mobile broadband. In addition, the mobile service definition covers a range of applications including mobile broadband, as well as other mobile systems used for applications such as business radio or public protection and disaster relief.
- 3.7 As well as confirming the co-primary allocation, the ITU will need to consider the refinement of the lower edge of the mobile allocation, currently set at 694 MHz. The band edge will determine how much spectrum is potentially available for mobile broadband and DTT and may also affect interference management between the two services.
- 3.8 Ofcom is actively engaged in international discussion on options for the lower band edge, with the objective of maximising the total benefit to UK consumers, by enabling mobile broadband use of 700 MHz while ensuring that DTT below the band edge is protected. Our current position is the band edge should be no lower than 694 MHz to ensure DTT has sufficient spectrum and that any guard band needed to protect DTT from interference from any future mobile broadband services above this is taken from the mobile allocation (i.e. above 694 MHz).

### **Agreeing the mobile band plan**

- 3.9 A band plan for mobile services in the 700 MHz band needs to be agreed at a European level. This would specify frequencies for the mobile uplink and downlink and the frequency separation (guard band) between mobile services and adjacent DTT services.
- 3.10 The CEPT is leading on the development of this plan in Europe under the mandate from the Commission. Ofcom is actively engaged in these discussions. At present we expect that agreement will be reached on a provisional European band plan by November 2014, with a final agreement following WRC-15.
- 3.11 One issue that is currently being considered in the context of those negotiations is whether or not there should be dedicated spectrum for Public Protection and Disaster Relief (PPDR) services in part of the band. There is a possibility that a portion of the 700 MHz band could be set aside for this purpose, either as a result of a Commission

harmonisation measure or a Government request. Any such allocation would have to be accommodated within the 700 MHz band plan.

- 3.12 We anticipate that stakeholder engagement in relation to both the WRC preparation and the CEPT work on the Commission mandate will be managed through the established international briefing process via the International Frequency Planning Group (IFPG) and its Working Group D (IFPG WGD). A description of the IFPG briefing process and its working groups can be found in our recent Call for Input on 'Future demand for mobile broadband spectrum and consideration of potential candidate bands'<sup>10</sup>; see paragraphs 6.10 to 6.13.
- 3.13 The IFPG WGD meets regularly prior to all key CEPT and ITU meetings where the 700 MHz band is discussed and it provides the forum for discussing and agreeing UK inputs to these meetings. The next IFPG WGD meeting relevant to 700 MHz is scheduled for 24 June – if you would like to get involved in this please contact its Chairman, Steve Green ([steve.green@ofcom.org.uk](mailto:steve.green@ofcom.org.uk)). However, if necessary, Ofcom will consider consulting on issues specifically related to the mobile band planning work later this year once work the mandate in CEPT is underway.

### Future DTT band plan

- 3.14 If there is a change of use of the 700 MHz band, DTT services would no longer be able to operate in that band. This means that the DTT frequency plan currently in use (the frequencies used at individual transmitter sites) would have to be modified such that all current DTT frequency allocations which fall into the 700MHz band would be re-allocated into the residual DTT broadcasting spectrum below the 700MHz band. This is relevant to the national television multiplexes, as well as to multiplexes with sub-national coverage (eg the local television multiplex).
- 3.15 In that event, the UK would need to internationally co-ordinate a new DTT frequency plan with neighbouring countries, in particular our nearest neighbours (Belgium, France, Ireland and the Netherlands). International frequency co-ordination can be conducted through a number of parallel bilateral processes whereby administrations from two neighbouring countries negotiate and agree revised frequency allocations. This is an iterative process that is carried out as each country develops its own new DTT frequency plan. Each individual country's frequency plans are in turn also dependent upon negotiations between the neighbouring country and that country's own neighbours (ultimately meaning that proposed changes in distant countries may affect the course of the UK's own negotiations). An underlying principle of bilateral agreements is to secure equitable spectrum rights across the band under discussion, such that one country does not gain improved access rights to spectrum at the expense of another.
- 3.16 There is also the possibility that an ITU Regional Radiocommunication Conference (RRC) could be convened to revise the current Geneva 2006 (GE-06) agreement. GE-06 contains the agreed DTT band plans for Europe and surrounding countries, though these band plans are relatively high-level (i.e. they only include allocations for each country's largest transmitters) and have been subject to subsequent bilateral amendments. Based on Ofcom's experience of the last RRC conference, bilateral negotiations are still likely to be required in addition to any future RRC. This is because more detailed bilateral co-ordination agreements are expected to be required to supplement the high-level national frequency plans which would result from the RRC process.

<sup>10</sup> <http://stakeholders.ofcom.org.uk/consultations/cfi-mobile-bb/>

- 3.17 Administrations participating in any future RRC could alternatively choose to pursue a more radical change to their DTT frequency plans (as opposed to revisions of the existing GE-06 plan). However such an approach would carry a higher degree of uncertainty as to the final outcome. In addition, while a radical change to frequency allocations may result in a more efficient use of DTT spectrum across Europe, such a change is likely to carry potentially higher implementation costs for many countries.
- 3.18 The time frames for reaching international co-ordination agreements (whether bilaterally or through an RRC process) are uncertain and dependent upon many factors such as the policy decisions taken nationally within the UK, by neighbouring countries, and most significantly at a European or wider international level. Based on previous experience of bilateral negotiations for Digital Switchover and for the 800 MHz DTT Clearance, an optimistic expectation is that the co-ordination process could take 3 to 4 years to complete. The alternative approach of an RRC process could potentially require longer timescales as the conference would take some time to be organised and resourced. In parallel, informal initial negotiations are likely to need to take place between participating countries. The RRC process does however have advantage of ensuring participants reach final co-ordination agreements at the conference itself.

### **Further European discussions about UHF bands IV and V**

- 3.19 The CEPT Electronic Communications Committee (ECC) meeting in March 2013 heard calls from a number of countries to consider studies on a long-term vision for the UHF broadcasting band. This has been prompted by WRC-15 agenda item 1.1 (additional spectrum allocations to the mobile service to facilitate the development of terrestrial mobile broadband), which has seen proposals into the ITU-R to consider a further mobile allocation in the 470-694 MHz spectrum. In response, ECC has set up a correspondence group to
- frame the studies to support the development of a long-term vision for the UHF band in Europe focusing primarily on technical issues, but addressing also economic, social and regulatory aspects; and
  - formulate key questions which have to be answered by the group which will be responsible for these studies, taking into account the need to collect data on existing situation in each CEPT country.
- 3.20 The ECC plans to decide on how to progress this work at its meeting in June 2013, based on the report from the correspondence group. The options would include setting up a new ECC Task Group or adding this work to the programme of an existing group.

## Section 4

# Assessing the costs and benefits of potential release

## Introduction

- 4.1 This section focuses on the questions of how we should assess the costs and benefits of a release of the 700 MHz band, and how the timing of any such release should be determined. We want to identify and, where possible and useful, quantify the costs and benefits which could result from any future release of the 700 MHz band. We also want to understand how these costs and benefits might vary depending on when any potential release of the band takes place.

## Understanding the costs and benefits of a change of use of the 700 MHz band

- 4.2 At this stage it is unclear how international developments may affect the questions of whether, or when, the 700 MHz band might be released. However, to the extent that the UK may have discretion in determining whether or when a 700 MHz release takes place, the information we are seeking in this Call for Inputs will help to inform those decisions. In the meantime, the information we are seeking here will help to ensure that our position in international discussions is informed about the best outcome for UK citizens and consumers. Understanding the costs and benefits may also inform future work on implementing a release of the 700 MHz band.
- 4.3 Below we set out our initial thinking on the costs and benefits we currently believe are relevant and the framework within which these costs and benefits might be assessed.

## Potential Costs

- 4.4 Any future release of the 700 MHz band would require a DTT frequency re-plan. A release of the 700 MHz band would also reduce the amount, and change the location, of geographic interleaved spectrum available for PMSE and white space device uses. We anticipate that the principal costs associated with any future release would relate to these changes.
- 4.5 **Changes to the DTT transmission network.** The 700 MHz band represents a significant proportion of the spectrum currently used for DTT broadcasting (96 MHz of the 256 MHz) and, as noted above, any future release of the 700 MHz band would involve a substantial frequency re-plan for DTT. We would anticipate that this would involve changes to certain transmission sites for example to replace combiners, transmitters antennas or strengthen masts. The extent of such network changes would depend on the DTT band plan that is agreed.
- 4.6 The choice of DTT band plan will be subject to international co-ordination and agreement with neighbouring countries, as discussed in Section 3, and is unlikely to be finalised until after WRC-15. We wish to develop an understanding of the likely costs involved prior to a final agreement on the DTT band plan. To that end, we are planning to initiate a high level study into how DTT transmission infrastructure would

need to be modified if the 700 MHz band were released. This understanding will be subject to refinement as a clearer view emerges of the likely DTT band plan.

- 4.7 **Consumer equipment replacement.** DTT frequency changes could lead to some households needing to replace equipment, such as aerials, in order to receive DTT channels broadcast in a different frequency range.
- 4.8 Aerials can be group-specific (covering part of the DTT frequency range) or wideband (covering the whole frequency range). The number of households affected by any future DTT frequency re-plan will depend on the choice of DTT band plan. Some viewers with band-specific aerials may need to replace their aerials. We are progressing work to audit the installed base of aerials, and to understand how many aerials may need to be replaced in different DTT band plan scenarios, and the associated cost.
- 4.9 In addition, if a change of some or all DTT capacity to the next generation of more efficient DVB-T2 and MPEG-4 transmission and compression technologies were required in order for DTT to continue to deliver near-universal PSB coverage and an overall number and coverage of DTT multiplexes similar to today, then some consumers would need to replace their DTT receivers. The number of consumers affected will depend on the number of consumers who have DTT equipment capable of receiving the more efficient standard at the time when transition takes place. We consider how both of these impacts could be reduced in Section 5.
- 4.10 **Coexistence between existing users and mobile broadband.** The current generation of TVs, set top boxes and equipment used to receive DTT, and some other equipment designed for use in the band (e.g. certain types of PMSE equipment) was designed to receive signals across the whole TV band, including the 700 MHz band. This means that any future use of the 700 MHz band for mobile services may create the potential for interference to DTT receivers and other existing users unless mitigating action were taken.
- 4.11 The scale of any interference and cost of mitigation will depend on both the DTT and mobile band plans, as well as the performance of DTT and PMSE receivers and mobile terminals (eg handsets). We are currently actively engaged with the international work on a mobile band plan. We are also considering ways to reduce the risk of interference by improving the performance of equipment, as discussed in more detail in Section 5.
- 4.12 **Consumer information and support.** In the event of 700 MHz release there may be a need for consumer information about any changes that affect them and the steps they may need to take to continue to receive DTT services, including support for vulnerable consumers during any transition. The extent of information and support required will depend in part on how many households are affected, which is highly uncertain at this stage for the reasons set out above.
- 4.13 **Opportunity cost of 600 MHz band.** Ofcom has recently consulted on proposals for the award of a licence to establish temporary DTT multiplexes in the 600 MHz spectrum band (550-606 MHz), for the interim period prior to 700 MHz release<sup>11</sup>. Our intention is that it will be awarded on the express basis that it is a temporary allocation prior to 700 MHz release. Nevertheless in the absence of a 700 MHz release, a possible counterfactual scenario would have been that 600 MHz band would not be needed to accommodate the current DTT multiplexes. This could allow

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<sup>11</sup> See footnote 8 above

for additional DTT channels or other services to be provided in the 600 MHz band. 700 MHz release would therefore entail an opportunity cost in that it would prevent consumers from benefitting from these additional DTT channels or other services in the 600 MHz band.

- 4.14 **Reduction in interleaved spectrum:** A future release of the 700 MHz band would be likely to reduce the availability of interleaved spectrum, in that:
- interleaved use of the 700 MHz band would no longer be possible; and
  - the other bands that would be used for DTT following 700 MHz release (470 MHz to 694 MHz) may need to be used more intensively for DTT, reducing the amount of interleaved spectrum available in these bands relative to what would otherwise be available.
- 4.15 As a result, current users of interleaved spectrum for PMSE could face costs of replacing equipment in order to use interleaved spectrum at different frequencies than at present (in the 470 MHz to 694 MHz range rather than 700 MHz), and there is also a risk that an overall reduction in the interleaved spectrum available could limit the services that could be provided in future, such as WSDs, compared to if the 700 MHz band remained available.<sup>12</sup> However, this reduction in spectrum is in part offset by the decision to retain access to the 600 MHz band for DTT and services sharing spectrum with DTT (ie PMSE and, in the future, WSDs).

## Potential Benefits

- 4.16 Our working assumption is that a future release of the 700 MHz band for mobile broadband services would confer significant benefits on citizens and consumers. We have identified a range of potential benefits from a possible future release of the 700 MHz band, as set out below.
- 4.17 **Meeting demand for mobile data services.** As the UHF Strategy Statement identified, the 700 MHz band could be particularly useful for meeting demand for mobile data services because of the propagation characteristics of low frequency spectrum. The extent of this benefit will depend on consumer demand for mobile data services, and the effectiveness of alternative means of avoiding a shortage of spectrum, such as the release of other spectrum bands or Wi-Fi offload. Any future release of the 700 MHz band is likely to reduce the number of mobile macro and small cells that need to be deployed / upgraded to meet mobile traffic demand, potentially leading to savings in mobile network infrastructure capital and operating costs. Consumers also benefit from lower prices to the extent that such cost savings are passed through (which depends on a range of factors such as the nature of the cost saving and the competitiveness of the market).
- 4.18 One approach to estimating this benefit might be to model the network infrastructure cost saving for MNOs from reducing the number of cells that need to be deployed to meet mobile broadband demand with additional spectrum at 700 MHz. Initial work on modelling this effect informed our UHF Strategy Statement.
- 4.19 **Improved indoor and rural coverage.** Additional sub 1 GHz spectrum may be especially valuable for mobile services compared to higher frequencies, because the

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<sup>12</sup> Ofcom's Annual Plan 2013/2014 notes our intention to conduct a strategic review of the use of spectrum by the PMSE sector. Our assessment of the impact of 700 MHz release on PMSE will have regard to this broader review.

better propagation characteristics mean that it could potentially sustain a better quality of service in hard-to-reach indoor and outdoor locations.

- 4.20 **Reduction in mobile handset costs.** There is a technical limit on the number of bands that can be supported in mobile handsets. Adding any further bands to a handset will entail a financial cost; however this cost is lower if the added band is internationally harmonised. Given the 700 MHz band will likely be globally harmonised, handsets with 700 MHz support are likely to be cheaper than having a handset made with an alternative UK specific band. Adding the 700 MHz band to UK handsets could therefore be seen as a cost associated with 700 MHz release, or as a benefit compared to the alternative of adding a different band, which is not globally harmonised, to UK handsets. In practice the reduction in mobile handset costs associated with 700 MHz release would also depend on how many and which countries adopt the same band plan as the UK. We expect that there would be a common band plan for Europe.
- 4.21 **Effective Competition.** There is a risk that growing demand for mobile broadband, combined with lack of access to suitable spectrum, could lead to network capacity constraints. This might be felt by consumers in the form of reduced competition and higher prices. A future release of the 700 MHz band could help to prevent such an outcome, potentially leading to lower prices through network cost savings (described above) and effective competition due to reduced barriers to expansion. One approach which has been used to estimate this type of benefit is to model the impact of spectrum release on consumer prices and use this to estimate the effect on consumer surplus<sup>13</sup>. Release of the 700 MHz band could also help to facilitate innovative market entry.
- 4.22 **Downstream market opportunities.** Improvements in mobile data capacity and coverage, such as from 700 MHz release, will allow greater development of web-based services.
- 4.23 **Emergency service use.** There is a possibility that the 700 MHz band could be used to provide Public Protection and Disaster Relief services, should it be released for mobile use. This would potentially reduce the spectrum available for mobile broadband and the associated benefits. However PPDR use could have benefits in the form of improved emergency services provision.

### Other issues in cost-benefit analysis

- 4.24 Assessment of the case for 700 MHz release will depend on the counterfactual against which the effect of release is measured. For instance, different counterfactuals may be necessary depending on whether we are seeking to inform our position in international discussions, or deciding whether to proceed with 700 MHz release when other countries have made this decision.
- 4.25 For example, if other European countries were to release 700 MHz spectrum for mobile broadband, some of the costs outlined above would be incurred whether or not the UK released the band. These costs could include co-existence costs such as the cost of improving DTT receivers and mobile handsets. It may also be the case that continued use of the band for DTT in the UK would cause significant frequency coordination problems. Depending on international negotiations this may require

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<sup>13</sup> For example Hazlett and Muñoz (2009) found that consumer prices were lower at higher levels of spectrum availability – see Hazlett, T. W. and Muñoz, R. E., “A welfare analysis of spectrum allocation policies”, The RAND Journal of Economics, 40: 424–454

some DTT frequency re-planning regardless of whether 700 MHz spectrum were released for mobile broadband use in the UK. Under these circumstances, a cost-benefit analysis informing whether or not to release 700 MHz spectrum in the UK would need to factor this into the analysis.

- 4.26 In the case of some of the types of cost and benefit, we may produce quantitative assessments of costs and benefits where sufficiently useful and robust estimates can be made. But some types of cost and benefit may be less amenable to quantification, although still important. Therefore, we will also consider qualitative arguments and evidence as to the likely scale of costs and benefits which may not be directly quantifiable.

*Question 1: Have we correctly identified and characterised the potential costs set out above, and what other costs – if any – should be taken into account in our assessment?*

*Question 2: What evidence, whether qualitative or quantitative, should we obtain and/or take into account in assessing each of these potential costs? Please identify any sources of specific evidence to which we should have regard.*

*Question 3: 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 4: 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 5: In particular, what is your view of the likely future demand for additional sub-1 GHz spectrum for the provision of mobile data services, and what evidence supports this view?*

*Question 6: Should we place different weights on some costs and benefits than on others, for example depending on whether costs would be borne by consumers, DTT operators, or mobile operators?*

*Question 7: Do you have any other comments on the work we are currently undertaking on potential costs and benefits?*

## The timing of a 700 MHz release

- 4.27 Our expectation is that we will use cost-benefit analysis as an input to inform our position on the future use of the 700 MHz band. As international and European developments progress we will seek to update our position accordingly. We also intend to update the cost-benefit analysis as new evidence becomes available. If a future release of the 700 MHz band is to take place, the cost-benefit analysis discussed above will also inform our thinking as to how to implement the release of that spectrum, including how to mitigate any adverse impacts release would have on consumers, and the optimal timing of release.
- 4.28 As set out in the UHF Strategy Statement, our current view is that 2018 is the earliest date at which the changes needed to release the 700 MHz band could take place. As we have noted above, timing of any future release could be dependent on, or strongly influenced by, the international context. Nevertheless, it is important for us to

have a view on what timing of release is in the best interest of UK citizens and consumers. If timing remains a decision for the UK, we need to be able to take that decision in a well-informed way. If timing of release is determined by, or becomes a consequence of, international decisions, we want to be able to influence and inform the discussion. We are considering two broad options to determine the timing of any potential future release.

- 4.29 We are currently planning on the basis that we will use the cost-benefit analysis outlined above to assess the impact of alternative transition dates, which would form the basis for our view on what timing of release would maximise net benefits to citizens and consumers. This is broadly consistent with the approach followed in Digital Switchover (DSO), where a cost-benefit analysis informed the Government's view that earlier release was preferable to later release<sup>14</sup>.
- 4.30 However, we are also exploring the possibility of using alternative options in which the release date would be determined by a market mechanism, such as an incentive auction or overlay auction, as described below.
- 4.31 Even in the context of a market mechanism determining the release date, some element of cost-benefit analysis is likely to be needed, for example in making the decision that the band should be cleared and subject to an incentive auction in relation to timing, and to inform elements of auction design. In any case, we expect that any future award of the 700 MHz spectrum would be through an auction.
- 4.32 The following paragraphs set out these options in turn. The discussion in the section below on the timing of release assumes, for the purposes of discussion only, that a decision to release the 700 MHz band for mobile broadband has been taken.

## Release date determined by Ofcom

- 4.33 A number of the potential costs and benefits outlined above could differ significantly depending on when release occurs. As noted in our UHF Strategy Statement, the need for new international agreements makes it likely that none of these changes will take place until 2018 at the earliest. When we refer to early release below, we mean 2018 or soon after 2018.

## Potential Costs

- 4.34 **Changes to the DTT transmission network:** In the event of a 700 MHz release, there may be a trade-off between the speed at which the necessary changes to the DTT infrastructure could be made, and the costs associated with these changes. We wish to establish what the optimal programme for implementing these changes would be, and the scope for, and cost implications of, adjusting the speed of such a programme.
- 4.35 **Consumer equipment replacement:** The proportion of households with wideband aerials may increase over time if more newly-installed aerials are wideband, so the number of aerial changes required by any transition, and the associated cost and disruption, may be greater with an earlier release. The natural replacement period for aerials is several years and so this will not be a strong effect, but short term use for the 600 MHz band for new DVB-T2 services might be expected to have a stronger

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<sup>14</sup> Department of Trade and Industry & the Department for Culture, Media and Sport, 10 Feb 2005, "Cost Benefit Analysis (CBA) of Digital Switchover", available at [http://www.digitaltelevision.gov.uk/pdf\\_documents/publications/CBA\\_Feb\\_2005.pdf](http://www.digitaltelevision.gov.uk/pdf_documents/publications/CBA_Feb_2005.pdf)

short term effect in encouraging an accelerated adoption of wideband aerials. In addition, if a change of some or all DTT capacity to the next generation if a change of some or all DTT capacity to the next generation of DVB-T2 and MPEG-4 transmission and compression technologies were required in order for DTT to continue to deliver near-universal PSB coverage and an overall number and coverage of DTT multiplexes similar to today, this would be less disruptive at a later date, as more households will have DVB-T2-compatible equipment over time.

- 4.36 **Opportunity cost of 600 MHz band:** An earlier release of the 700 MHz band would result in a shorter period of interim use of the 600 MHz band, and this will tend to reduce the benefits associated with interim use of this spectrum for DTT, PMSE and WSDs. Our UHF Strategy Statement noted that expanding the range of HD services available on the DTT platform would strengthen its ability to deliver consumer benefits”, and also that over time, the expanded range of services available could provide incentives for consumers to accelerate the take-up of DVB-T2 MPEG-4 compatible receivers. If this were the case, this could facilitate a faster migration of the DTT platform to these more efficient standards.” If the 700 MHz band is released sooner rather than later, there will be less time for these benefits from interim use of the 600 MHz band to materialise.
- 4.37 **Reduction in interleaved spectrum:** Users of interleaved spectrum may also be affected by the timing of any 700 MHz release, for example a later transition date could allow such users greater scope to manage the cost of changing equipment, and potentially give manufacturers more time to develop suitable equipment solutions.

### Potential Benefits

- 4.38 However, an earlier release date could also bring forward the potential benefits associated with use of the 700 MHz spectrum outlined above, while a later release might defer those potential benefits.
- 4.39 **Meeting demand for mobile data services:** As noted above, release of 700 MHz spectrum could be important in meeting demand for mobile services and avoiding a shortage of spectrum. If release were to occur at a later date, the benefits to consumers of this effect might be delayed. In addition, there is a risk that mobile operators might respond to a short term capacity constraint by investing in network infrastructure that would not have been needed with an earlier release of 700 MHz spectrum, leading to higher costs which might be passed on in retail prices.
- 4.40 **Improved indoor and rural coverage:** Later release of 700 MHz spectrum could delay consumers obtaining the benefits of the better quality mobile data services in hard-to-reach indoor and outdoor locations that could be delivered using this sub-1 GHz spectrum.
- 4.41 **Effective Competition:** A timely release of 700 MHz spectrum could help to ensure that all mobile operators have the spectrum they need to continue to be effective competitors, even with strong growth in demand for mobile data services.

*Question 8: Have we correctly identified the costs and benefits that could vary depending on the timing of release, and the impact of those factors? Are there other costs and benefits which would vary depending on the timing of release of the 700 MHz band which we should take into account?*

*Question 9: How quickly could the 700 MHz band be released? What would be the impact on DTT infrastructure costs of releasing at the earliest possible time compared to a later time? What would be the factors which affect these costs?*

*Question 10: How, and to what extent, are the costs for existing (PMSE) and potential (WSD) interleaved users of the 700 MHz band likely to vary depending on the timing of release? What would be the factors which affect these costs?*

*Question 11: Should we consider any other cost-related arguments / evidence in favour of an earlier or later release date?*

*Question 12: What would be the impact on mobile broadband delivery and competition of releasing the 700 MHz band later rather than sooner?*

*Question 13: Should we consider any other benefit-related arguments / evidence in favour of an earlier or later release date?*

## Release date determined by market mechanism

- 4.42 The cost-benefit analysis approach outlined above is broadly similar to the approach used by Ofcom in previous spectrum releases, such as the 800 MHz band<sup>15</sup>. However, we are also considering the scope for decisions around the timing of a possible 700 MHz release to be determined by a market mechanism. Such a market mechanism would allow for market participants to reveal their preferences for the optimum release date rather than Ofcom leading the decision.
- 4.43 In principle, such a mechanism could determine the timing of release by allowing current users to express how much they would value ongoing use of the spectrum, and prospective new users to express how much they would value acquiring the spectrum. We would, in any case, expect that released 700 MHz spectrum would be awarded via an auction.
- 4.44 In practice there are a number of limitations to the use of a market mechanism in this case:
- As noted above and in Section 3, international developments are likely to have a role in determining whether and when 700 MHz release will occur. We also expect that the amount of spectrum released will be determined internationally with Ofcom's involvement. It may be that only the timing of release will be determined in the UK, perhaps within a relatively narrow window. In view of this, we have focused here on the scope for a market mechanism to determine the timing of release. In practice, this would mean determining whether prospective users of the spectrum would place a higher value on release at an earlier date than current users would place on deferring release to a later date (where at this stage the choice of specific dates in question have yet to be determined).
  - While a market mechanism could determine the respective valuations of licensed users of the spectrum and prospective future users at different dates, other groups of stakeholders could be affected by the timing of release. For example, as described above the timing of release could have an impact on equipment costs for PMSE users of interleaved spectrum; consumers could face more disruption and higher costs of replacing equipment in the case of an earlier

<sup>15</sup> See <http://stakeholders.ofcom.org.uk/consultations/800mhz/>

release, but they could also benefit from stronger competition in the supply of mobile broadband services.

- 4.45 However, we are considering whether, notwithstanding these limitations, there may be scope to use a market mechanism in this case. This is consistent with Ofcom's view that market mechanisms, such as auctions, are in most cases more likely to promote the interests of citizens and consumers than regulator-led decisions.
- 4.46 We have identified two different potential market mechanisms: incentive auctions and overlay auctions. These are outlined below. Please note that not all of the features described would necessarily be relevant to this case.

### Incentive auctions

- 4.47 One potential means of determining the appropriate timing of release is to use an 'incentive auction'. DCMS recently described an incentive auction as "a voluntary, market-based tool to compensate existing spectrum licensees for returning their licences to make spectrum available for innovative new uses"<sup>16</sup>. To expand on this description, an incentive auction is one in which:
- existing spectrum licensees have a choice of whether to relinquish some or all of the spectrum they currently use (e.g. as set out in their licences);
  - new users bid for future use of the spectrum in a standard auction; and
  - existing users receive some form of consideration from the auction proceeds.
- 4.48 An incentive auction can therefore be seen as a two-sided auction with existing users of spectrum effectively selling access to spectrum on the supply side and new users purchasing access to spectrum on the demand side. As discussed above, in the specific case of an incentive auction for 700 MHz release, we would expect the relinquishment of rights to centre on timing of release in the context of continued provision of the DTT platform through a DTT frequency re-plan and the 600 MHz band being made available for DTT.
- 4.49 Incentive auctions are a new and innovative form of auction design. In the USA, the Federal Communications Commission (FCC) is currently taking steps to release spectrum via an incentive auction, and this is the first case of an incentive auction being used for spectrum. In October 2012 the FCC issued a Notice of Proposed Rule Making for an incentive auction<sup>17</sup>. This involves terrestrial broadcasters (the existing users), having the opportunity to relinquish their spectrum rights voluntarily thereby supplying spectrum in the 600 MHz band. This spectrum is expected to be purchased and used by new users on the demand side, such as mobile broadband operators, or for use by WSDs etc.
- 4.50 The FCC is seeking to determine both the amount of spectrum released by broadcasters and its location (in both frequency and geography). In other words, there is not a fixed supply of spectrum known in advance of the FCC's auction – instead it will be determined through the auction. In contrast, in the specific context of a potential release of the 700 MHz band, we are considering whether an incentive

<sup>16</sup> See paragraph 4.47 below for the full quote and reference

<sup>17</sup> Federal Communications Commission, NPRM, 2 Oct 2012, "Expanding the Economic and Innovation Opportunities of Spectrum Through Incentive Auctions", available at <http://www.fcc.gov/document/broadcast-television-spectrum-incentive-auction-nprm>

auction may be of use in determining the timing of release only; that is, for example, with a decision being made that release would take place by a final date and the incentive auction element being used to determine if release could take place at an earlier point in time.

- 4.51 At present Ofcom does not have the necessary legal powers to undertake an incentive auction. However, we note that the possibility of introducing the necessary powers has been recently raised by DCMS in the Communications Review Seminar Series<sup>18</sup> which commented:

“Promoting use of spectrum to support economic growth and growing demand might also be achieved if Ofcom were given a power to conduct incentive auctions. An incentive auction is a voluntary, market-based tool to compensate existing spectrum licensees for returning their licences to make spectrum available for innovative new uses like mobile broadband. Ofcom would auction the spectrum that licensees voluntarily return, with licensees retaining a portion of the auction proceeds.”

- 4.52 Ofcom responded to this discussion paper, commenting that:

“We agree that it could be very useful to have this additional way of enabling spectrum to change hands, and to change uses, in future. At present, while we can include spectrum that is licensed to existing users in an award, there is no statutory means for such existing users to receive any of the amount paid for his spectrum. If this were changed, it could reduce the transaction costs, and risk, for a licensee wishing to test the market for his spectrum who would otherwise have to go to market on his own behalf. Reducing the transaction costs of trading spectrum in this way could increase the likelihood of spectrum finding the most efficient use and user. Incentive auctions could also facilitate greater efficiency by providing a mechanism for co-ordination between potential suppliers of spectrum rights (existing licensees) and/or potential purchasers, when this might be otherwise be difficult to achieve.”<sup>19</sup>

- 4.53 In light of those potential developments we are seeking views as to whether an incentive auction could be effective and appropriate in the context of a potential future release of the 700 MHz band.
- 4.54 The potential advantage of holding an incentive auction to determine the release date depends on a number of factors, notably:
- the range of possible release dates, and whether there are significant differences in likely costs and benefits between these dates;
  - whether an efficient incentive auction would be likely to lead to a socially optimal outcome which maximises the benefits for citizens and consumers; and
  - whether an appropriate incentive auction can be designed in this case.
- 4.55 Annex 5 presents an illustrative example of an incentive auction, and considers the three points raised above.

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<sup>18</sup> Department for Culture, Media and Sport, “*Maximising the value of spectrum to support growth and innovation*”, available at <http://dcmscommsreview.readandcomment.com/spectrum/>

<sup>19</sup> Ofcom, Sep 2012, “*Maximising the value of spectrum to support growth and innovation. Response to the Department for Culture, Media and Sport’s discussion paper*”, p 6, available at [http://stakeholders.ofcom.org.uk/binaries/consultations/ofcomresponses/Ofcom\\_DCMSspectrum.pdf](http://stakeholders.ofcom.org.uk/binaries/consultations/ofcomresponses/Ofcom_DCMSspectrum.pdf)

## Overlay auction

- 4.56 An overlay auction is one in which the winner of the auction must share the spectrum with the incumbent user and avoid harmful interference taking place. The incumbent users then have the choice whether to relinquish some or all of their rights to the spectrum they currently use in return for a commercially negotiated payment from the new user. In the case the potential future release of the 700 MHz band we might expect the negotiations following an overlay auction to determine the timing of release. The key difference to an incentive auction is the payment to relinquish spectrum rights is commercially negotiated between the incumbent and new users, rather than through an auction process.
- 4.57 The first stage of an overlay auction is the same as a traditional auction i.e. the spectrum is sold to the new users. However, in the case of an overlay auction, the spectrum is not cleared of incumbent users when sold. Rather, the winners of the auction can then negotiate with the incumbent users for greater rights to the spectrum, for example complete release of the band or early release in specific geographical areas or frequency ranges.
- 4.58 Similar to an incentive auction an overlay auction would have the advantage of reducing the information uncertainty that Ofcom would face in determining a release date. A second advantage of an overlay auction is that the commercial negotiation stage could in principle reach a more tailored outcome than is likely to be possible in either an incentive auction or Ofcom led process. For example the negotiation stage may result in a phased release in different parts of the country (where this is possible).
- 4.59 One problem with the negotiation stage following an overlay auction is it may lead to complex negotiation between multiple buyers and sellers trying to agree on a single release date. As with incentive auctions, if practical and international factors limited the range of possible release dates there may be little advantage to an overlay auction. In contrast, an incentive auction is a multi-lateral process and so in principle might be able to achieve the desired co-ordination between buyers and sellers more efficiently.
- 4.60 Again as with incentive auctions, an overlay auction would reflect only the private value of auction participants, and not the broader social value of earlier or later 700 MHz release.
- 4.61 An overlay auction might be less complex than an incentive auction, in that there is only one set of bidders. However, this relative simplicity would be achieved at the expense of leaving some aspects of the exchange of spectrum to subsequent negotiations, which might not lead to an efficient outcome. In particular, there is a risk that new users would, at the time of bidding in the auction, be uncertain as to whether or not the incumbent users will relinquish their rights and the terms upon which they would be prepared to do so.

*Question 14: Is the range of potential dates for release likely to be wide enough to merit consideration of an incentive auction approach?*

*Question 15: If so, what are the challenges to designing an effective incentive auction in this case, and how might these challenges be addressed?*

*Question 16: If we followed an incentive auction approach, how should we take account of wider costs and benefits – i.e. those not felt by participants in the auction?*

*Question 17: Do you have any views at this stage as to the parameters of an incentive auction, such as the default date and payment mechanism?*

*Question 18: Is there a version of the overlay auction approach which could be suitable for 700 MHz release?*

*Question 19: What are the benefits and risks of conducting an overlay auction in this case?*

## Section 5

# Consumers and equipment

## Introduction

- 5.1 An important part of our work in the context of a potential release of the 700 MHz band is to explore opportunities for reducing and potentially avoiding costs and disruption to citizens and consumers, such as those related to the need to modify or bring forward the replacement of equipment.
- 5.2 This section outlines our current thinking on the potential for disruption and costs and the possible pre-emptive measures we have identified that could be taken in advance of any future change of use of the 700 MHz band.
- 5.3 The scale of the potential impact on citizens and consumers depends largely on the nature of any future re-plan of the DTT platform and the band plan developed for future mobile use of the 700 MHz band. For example, if there are few changes to the frequencies used for DTT, this would reduce the number of consumers that may need to replace their aerials, and the magnitude of the risk of interference from mobile broadband services to DTT receivers is dependent on the band edge and guard band determined as part of the mobile band plan for the 700 MHz band.
- 5.4 At this stage it is too early to say with certainty what the final DTT or mobile band plan will look like, and we can't therefore fully assess the potential impact on citizens and consumers. We are taking these considerations into account in our work to develop band plans and engage in the international discussions, described in more detail in section 3. Closer to the time of any change of use of the band, we will need to assess again the potential impact and consider whether any further mitigating action or consumer support would be appropriate.

## DTT viewers

- 5.5 We have identified the following impacts as relevant to consumers accessing DTT services (including local TV) should the 700 MHz band be released for use by mobile broadband services in the future:
  - changes in the DTT band plan could mean that some consumers need to replace their aerials;
  - mobile services in the 700 MHz band may cause interference to DTT receivers operating below this band;
  - it is possible, depending on the outcome of the band planning work for DTT, that the DTT platform may require a (full or partial) change to the next generation of more efficient DVB-T2 and MPEG-4 transmission and compression technologies in order for DTT to continue to deliver near-universal PSB coverage and an overall number and coverage of DTT multiplexes similar to today. In that scenario some viewers may need to replace their receivers (TVs or set top boxes) to continue to receive all DTT channels.

## Impact of potential change in DTT band plan on aerials

- 5.6 A future release of the 700 MHz band would require a re-plan of the frequencies used for DTT. For the majority of households, it is likely that a future re-plan would only require a re-tune of their existing DTT receiver (in areas where the transmitter frequencies would have changed). For some households, a future re-plan could mean that they would need to use a different aerial to receive DTT.
- 5.7 TV aerials can be divided into two broad categories: grouped aerials, which are only capable of receiving specific frequency ranges within the bands used for DTT; and wideband aerials which are capable of receiving frequencies from across the entirety of the spectrum used for DTT.
- 5.8 A household would only be affected by a DTT re-plan if the household watches DTT (this could be on the household's primary TV set or secondary sets); the rooftop aerial is grouped rather than wideband; and the aerial would no longer deliver a sufficient signal on the new frequencies following a DTT re-plan. If all of these conditions hold, the household would need to replace its grouped aerial with a wideband aerial to continue watching DTT. We said in the UHF Strategy statement that between 0.1 and 0.3% of households may need to use a different aerial to continue to access PSB services, whilst a larger proportion (between 9 and 30%) may require a different aerial to access services from all of the commercial multiplexes. These figures were based upon an initial study and the actual number of households affected will depend upon the final DTT frequency plan.
- 5.9 We are currently progressing work to study the impact of different DTT frequency re-plan scenarios and one of the outputs of this study will be providing estimates on the number of households that may be affected based on the different scenarios. Initial results suggest that the number of aerials affected lies towards the lower estimate of figures indicated in the UHF Statement. We plan to publish the DTT frequency re-plan studies in due course.
- 5.10 To further understand the magnitude of this potential impact, we are also conducting an audit of what aerials are currently in use by households to watch DTT, which will enable us to estimate, for a given re-plan, how many households are likely to be affected.
- 5.11 Additionally, we believe that our planned approach to ensure that the 600 MHz band can be used for any future DTT re-plan will improve the prospects of achieving the widest possible compatibility of DTT services with existing roof-top aerials, by providing greater flexibility over how a frequency re-plan of the DTT platform is implemented.
- 5.12 Based on our initial work on pre-emptive measures that we could take to mitigate potential impact on consumers, we have identified the following:
- Consumer messaging - work with the aerial industry to ensure that consumers receive the correct information on what aerials are compatible with a future release of the 700 MHz band if they replace their aerials now.
  - Industry messaging – work with the aerial industry to ensure that they are informed on potential future changes and encourage promotion and wider availability of aerials which are compatible with a potential future release of the 700 MHz band.

## Impact of potential interference between DTT and mobile services

- 5.13 If the 700 MHz band were released for mobile services, there is the potential for future mobile services operating in the 700 MHz band to interfere with DTT receivers (TVs and set top boxes) operating in the band below. Unlike LTE in the 800 MHz band, current international discussions on mobile band planning suggest that the main source of this possible interference is likely to be the mobile terminals (e.g. mobile devices) rather than the mobile base stations. This means that the interference levels to DTT in the immediately lower band would probably be lower compared to what is expected in the 800 MHz case but the number of consumers experiencing interference could potentially be greater. This is because the mobile devices transmit lower powers than the base stations and because they could be located anywhere within close proximity to DTT receivers, whereas mobile base stations are in fixed locations.
- 5.14 The magnitude of potential interference to DTT from mobile devices depends on several factors:
- the separation between the frequencies used for mobile terminals and DTT receivers (the guard band)<sup>20</sup>;
  - how sensitive the DTT receiver is to interference (the receiver selectivity or in the presence of band edge filtering); and
  - how much interference the mobile handset is allowed to cause outside its intended transmit frequency (the out of band emission).
- 5.15 Based on our initial work on pre-emptive measures that could be taken to mitigate the potential impact on consumers, we have identified the following:
- Support improvement in DTT receivers – engaging with industry to encourage improvements to the performance of DTT receivers to reduce susceptibility to interference from mobile services. We are planning to initiate some research to understand the extent to which the performance of DTT receivers can be improved considering technological and cost constraints.
  - Support tightening of mobile terminal out of band emission masks - engaging internationally on mobile band planning and on the need to have a tighter mobile terminal emission mask to reduce the risk of coexistence issues arising. We are planning to initiate some research to understand the extent to which mobile terminal emission masks can be improved considering the technological and cost constraints.

*Question 20: Have we correctly identified and characterised the potential impact of 700 MHz release on consumers accessing DTT? What other impact – if any – should be taken into account in order to identify pre-emptive measures to reduce this impact?*

*Question 21: Do you have any comments on the pre-emptive measures relevant to DTT identified above? Are there other pre-emptive measures we should be considering?*

<sup>20</sup> This will be decided at WRC-15.

## Impact of potential migration to DVB-T2

- 5.16 We said in the UHF Strategy Statement that we would support any longer term market-led transition of the DTT platform to more efficient broadcast standards, and that this may be beneficial in enabling a smooth release of the 700 MHz band. This is because if DTT multiplex operators adopt these more efficient transmission technologies in the future, that could increase the broadcast capacity and enable greater flexibility in achieving multiplex coverage levels.
- 5.17 Our objective is for DTT to be able to continue to deliver near-universal PSB coverage and an overall number and coverage of DTT multiplexes similar to today, in the event that there is a change of use of the 700 MHz band. At this stage, it is not clear whether a (full or partial) change to the next generation DVB-T2 and MPEG-4 transmission and compression technologies would be necessary in order to fulfil that objective.
- 5.18 In our consultation on the award of the 600 MHz band<sup>21</sup> we outlined our proposals for the award of a licence to establish temporary DVB-T2 multiplexes in the 600 MHz band. We will consider further in 2013 the role of more efficient technologies in the future development of the DTT platform, and the factors that will need to be taken into account when considering any future request from DTT individual multiplex operators to convert to DVB-T2 and MPEG-4 operation.
- 5.19 At the time of any future further platform transition to these technologies, DTT viewers who do not already have compatible receivers (TVs or set top boxes) would need to replace their receivers (TVs or set to box) to continue to receive all DTT channels.
- 5.20 We noted in the UHF Strategy Statement that industry forecasts indicate that by the end of 2018, the uptake of DVB-T2/MPEG-4 receivers is likely to reach approximately 80% of primary sets relying on DTT. These projections are indicative and they will depend on the trend of DVB-T2 take-up. We have commissioned further research to understand the factors affecting consumer take-up of DVB-T2 receivers both on primary and secondary sets including whether consumers are able to distinguish between Freeview HD logos (indication of DVB-T2 compatibility) and other industry HD logos. We note that there are other technical developments that may also be relevant to consider in this context, for example the potential future use of the HEVC compression standard.
- 5.21 Based on our initial work on further measures that we could take to help acceleration of consumer adoption of DVB-T2/MPEG-4 receivers, we have identified the following:
- Consumer messaging - working with industry to raise consumer awareness of DVB-T2 equipment compatibility.
  - Industry messaging - work with industry to understand the extent to which DVB-T equipment will continue to be available on the market in the future.

*Question 22: Have we identified the correct measures to support consumer adoption of DVB-T2?*

*Question 23: What regard, if any, should we have to wider technical evolution of the DTT platform, such as HEVC?*

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<sup>21</sup> See footnote 8

## Users of geographically interleaved spectrum

5.22 Due to the configuration of the DTT frequency plan not all channels in UHF Band IV/V are used for DTT in a given area. This unused spectrum is called Geographic Interleaved (GI) spectrum and is currently used by PMSE and will, in the future, also be available for white space devices (WSDs).

### Impact on PMSE users

5.23 PMSE use of interleaved spectrum in the 700 MHz band primarily consists of wireless microphones and in-ear monitors, although there is some use of talkback and other audio links.

5.24 A future release of the 700 MHz band for mobile use would require a change in the band plan for the provision of DTT services and therefore the availability and location of GI spectrum. As we noted in the UHF Strategy Statement, this could have two main impacts on PMSE users:

- a reduction of the total amount of spectrum available to PMSE and
- users having to change or modify their existing equipment if not capable of re-tuning to the new frequencies.

5.25 To mitigate the impact of reduction in the amount of interleaved spectrum that would be available to PMSE if the 700 MHz band were released, the UHF Strategy statement confirmed that PMSE will have access to the 600 MHz band until such time as new DTT services are deployed and, thereafter, will continue to have access to interleaved spectrum in the 600 MHz band.

5.26 We are currently progressing work to study the impact of different DTT frequency re-plan scenarios if the 700 MHz band were released for mobile services. One of the outputs of this study will assess the impact on availability of geographically interleaved spectrum.

5.27 The extent to which PMSE users would need to change or modify existing equipment depends on how much of that equipment operates (only) in frequencies in the 700 MHz band at the time of release. Our understanding is that, following DSO, a large proportion of PMSE users are now using equipment operating below the 700 MHz band. However, we do not currently have sufficient information about the composition of PMSE equipment in the market to be able to assess the impact on it. Therefore, we plan to work with PMSE users and industry to understand better the impact on PMSE users of a potential future 700 MHz band release.

5.28 Based on our initial work on pre-emptive measures that we could take to reduce the potential impact on PMSE users, we have identified the following:

- Support industry efforts to improve PMSE equipment – engaging with PMSE manufacturers and industry to support continued efforts to improve PMSE equipment and its ability to operate in more fragmented GI spectrum, considering technological and cost constraints.
- Industry messaging – confirm the ongoing availability of 600 MHz for PMSE users and work with industry to promote awareness of equipment operating below the 700 MHz band as less vulnerable to potential future changes in availability of GI spectrum.

- 5.29 Additionally, there is a risk that future mobile services operating in the 700 MHz band might interfere with PMSE receivers operating in the adjacent band. In May 2012 we published a report<sup>22</sup> on the potential for LTE interference from mobile handsets operating at 791- 862 MHz to wireless audio, including microphones, in the band 863-865 MHz. This report concluded that mobile handsets are unlikely to cause harmful interference to wireless audio, including microphones, unless the audio equipment is operating at extended range and the mobile handset is close to the receiver. We expect that a similar conclusion would apply to mobile interference from the 700 MHz band to PMSE equipment below 694 MHz. However, we intend to carry out further studies to understand better the impact in this case.

*Question 24: Have we correctly identified and characterised the potential impact of 700 MHz release on PMSE users? What other impact – if any – should be taken into account in order to identify pre-emptive measures to mitigate this impact?*

*Question 25: Do you have any comments on the pre-emptive measures identified above? Are there other pre-emptive measures we should be considering?*

*Question 26: Do you have suggestions for how we can assess the impact on PMSE users and equipment if 700 MHz is no longer available for PMSE use?*

## Potential impact on future White Space Devices

- 5.30 WSDs are being developed to operate in spectrum unused by DTT and PMSE services in specific locations, on the basis that they would not cause interference to these services. Ofcom is working to put in place regulations<sup>23</sup> to enable WSDs to operate on a licence-exempt basis in the geographically interleaved UHF spectrum subject to complying with technical parameters from a geo-location database.
- 5.31 Similar to PMSE, potential release of spectrum at 700 MHz for mobile services would reduce the overall amount of interleaved spectrum available for WSDs. As with PMSE, we indicated in the UHF Strategy Statement that a combination of PMSE and WSD services will be authorised to access spectrum in the 600 MHz band to reduce the impact of any future 700 MHz release.
- 5.32 We expect that WSDs will be designed to operate across the whole UHF TV band. Therefore, we don't expect a potential future release of the 700 MHz band to have a significant impact on the functioning of these devices. However, as part of our work related to WSDs we will seek to ensure that stakeholders are fully informed about potential future changes in availability of interleaved spectrum for WSDs.

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<sup>22</sup> Ofcom, 9 May 2012, "Potential for LTE interference to Wireless Audio. Report", available at [http://stakeholders.ofcom.org.uk/binaries/consultations/tlc/annexes/Wireless\\_Audio\\_Testing.pdf](http://stakeholders.ofcom.org.uk/binaries/consultations/tlc/annexes/Wireless_Audio_Testing.pdf)

<sup>23</sup> See <http://stakeholders.ofcom.org.uk/consultations/whitespaces/?a=0>

## 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 Friday 5 July 2013**.
- A1.2 Ofcom strongly prefers to receive responses using the online web form at <http://stakeholders.ofcom.org.uk/consultations/700mhz-cfi/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 [UHFSI@ofcom.org.uk](mailto:UHFSI@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.
- Jon Higham  
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 Jon Higham on 020 7981 3673.

## 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](http://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/about/accoun/disclaimer/>

## Next steps

- A1.11 Following the end of the period for inputs, Ofcom intends to communicate further about this work by 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](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 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](mailto: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](mailto: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](http://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/](http://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

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 The consultation above has identified the following key questions on which we are consulting. Respondents are also welcome to raise other issues on which they would like to comment.

*Question 1: Have we correctly identified and characterised the potential costs set out above, and what other costs – if any – should be taken into account in our assessment?*

*Question 2: What evidence, whether qualitative or quantitative, should we obtain and/or take into account in assessing each of these potential costs? Please identify any sources of specific evidence to which we should have regard.*

*Question 3: 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 4: 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 5: In particular, what is your view of the likely future demand for additional sub-1 GHz spectrum for the provision of mobile data services, and what evidence supports this view?*

*Question 6: Should we place different weights on some costs and benefits than on others, for example depending on whether costs would be borne by consumers, DTT operators, or mobile operators?*

*Question 7: Do you have any other comments on the work we are currently undertaking on potential costs and benefits?*

*Question 8: Have we correctly identified the costs and benefits that could vary depending on the timing of release, and the impact of those factors? Are there other costs and benefits which would vary depending on the timing of release of the 700 MHz band which we should take into account?*

*Question 9: How quickly could the 700 MHz band be released? What would be the impact on DTT infrastructure costs of releasing at the earliest possible time compared to a later time? What would be the factors which affect these costs?*

*Question 10: How, and to what extent, are the costs for existing (PMSE) and potential (WSD) interleaved users of the 700 MHz band likely to vary depending on the timing of release? What would be the factors which affect these costs?*

*Question 11: Should we consider any other cost-related arguments / evidence in favour of an earlier or later release date?*

*Question 12: What would be the impact on mobile broadband delivery and competition of releasing the 700 MHz band later rather than sooner?*

*Question 13: Should we consider any other benefit-related arguments / evidence in favour of an earlier or later release date?*

*Question 14: Is the range of potential dates for release likely to be wide enough to merit consideration of an incentive auction approach?*

*Question 15: If so, what are the challenges to designing an effective incentive auction in this case, and how might these challenges be addressed?*

*Question 16: If we followed an incentive auction approach, how should we take account of wider costs and benefits – i.e. those not felt by participants in the auction?*

*Question 17: Do you have any views at this stage as to the parameters of an incentive auction, such as the default date and payment mechanism?*

*Question 18: Is there a version of the overlay auction approach which could be suitable for 700 MHz release?*

*Question 19: What are the benefits and risks of conducting an overlay auction in this case?*

*Question 20: Have we correctly identified and characterised the potential impact of 700 MHz release on consumers accessing DTT? What other impact – if any – should be taken into account in order to identify pre-emptive measures to reduce this impact?*

*Question 21: Do you have any comments on the pre-emptive measures relevant to DTT identified above? Are there other pre-emptive measures we should be considering?*

*Question 22: Have we identified the correct measures to support consumer adoption of DVB-T2?*

*Question 23: What regard, if any, should we have to wider technical evolution of the DTT platform, such as HEVC?*

*Question 24: Have we correctly identified and characterised the potential impact of 700 MHz release on PMSE users? What other impact – if any – should be taken into account in order to identify pre-emptive measures to mitigate this impact?*

*Question 25: Do you have any comments on the pre-emptive measures identified above? Are there other pre-emptive measures we should be considering?*

*Question 26: Do you have suggestions for how we can assess the impact on PMSE users and equipment if 700 MHz is no longer available for PMSE use?*

## Annex 5

# Incentive auctions

A5.1 This annex sets out a simplified and purely illustrative example of an incentive auction in the context of 700 MHz release and some of the factors that influence the relative merits of incentive auctions.

## Illustrative example of incentive auction procedure

A5.2 The purpose of the following example is to provide an illustrative explanation of the incentive auction idea – it does not indicate our preference for the form of such an auction. In practice there may be a range of design options for the auction, with significant implications for its effectiveness.

A5.3 Conceptually, we can think of the auction as comprising two components:

- a. selling the spectrum in the 700 MHz band to the new users; and
- b. determining the release date through an incentive auction.

A5.4 The essence of the idea is that the new users make bids to pay for:

- a. licences for spectrum in the 700MHz band – this is component (i); and
- b. release before the default date, ie earlier start for their 700MHz licences – this is component (ii).

A5.5 Only component (ii) is relevant to existing users and they make “supply bids” on the (lowest) payment they would be willing to accept in return for releasing the spectrum earlier than the default date.

A5.6 In an incentive auction, some or all of the payments by the new users for component (ii) - the release date - which is determined through the auction, would go to the existing users in order to secure an earlier release date. The payments by the new users for component (i) would go to the Government as is the case at present for spectrum auctions.

## Numerical example

A5.7 So, purely for illustration, assume we specify a default date of 2026 and an earlier date of 2018:

- a. Existing users make “supply bids” on the amount of money they would need to receive to accept the release date being brought forward to 2018 (ie to at least compensate them for their additional costs of releasing the 700MHz band in 2018 rather than 2026). Assume this is 100.
- b. New users make two sets of “demand bids” for spectrum in the 700 MHz band:
  - i. one for spectrum at the default release date of 2026 – assume this is 800; and

- ii. another for spectrum at the earlier release date of 2018 – assume this is 1000.

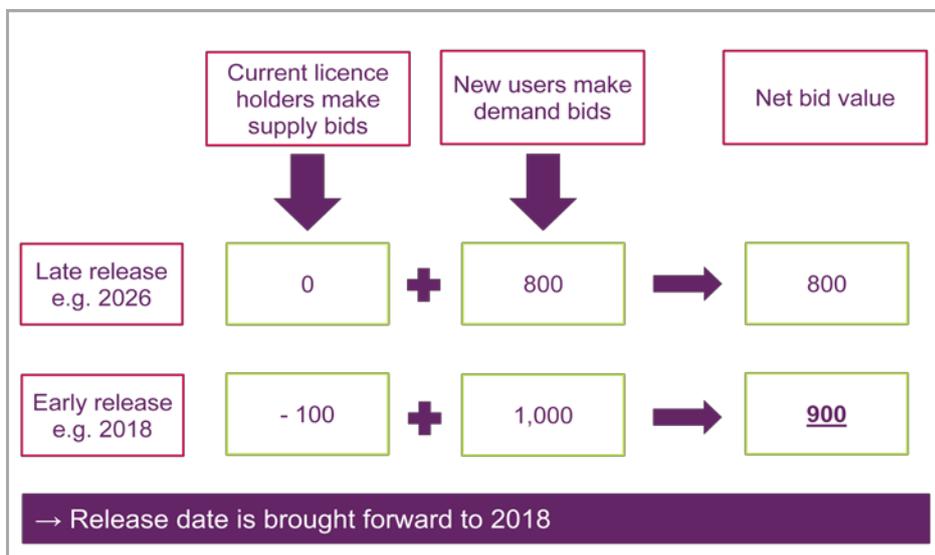
A5.8 In this numerical example, the additional willingness to pay of the new users for an earlier release date for the 700 MHz band of 2018 over the default date of 2026 (1000 – 800 = 200) is larger than the amount the existing users state in their supply bids they are willing to accept for the earlier release date of 2018 (100). So the auction determines that the release date is brought forward to 2018. This is illustrated below.

A5.9 As to payments, these depend on the specific pricing rules, but purely for illustration:

- a. Existing users might receive 100 as per their supply bids.
- b. New users might pay 100 for the earlier release date, component (ii) – this goes to the existing users.
- c. New users might also pay 800 for component (i), which goes to the Government.

A5.10 The concept therefore is that the auction can achieve the outcome and allocation it would have anyway with the default release date. But it also determines if it is efficient to bring forward the release date and in doing so it determines the level of payments necessary to do so.

**Figure A1: Illustrative example of an incentive auction**



### Factors influencing the advantages of an incentive auction

A5.11 In Section 4 we outlined a number of factors which would influence the potential advantages of holding an incentive auction, notably:

- the range of possible release dates, and whether there are significant differences in likely costs and benefits between these dates;
- whether an efficient incentive auction would be likely to lead to a socially optimal outcome; and

- whether an appropriate incentive auction can be designed in this case.

A5.12 We consider each of these points in more detail below.

### **Range of release dates, and cost implications**

A5.13 As noted above, our current view is that 2018 is the earliest practical date at which the 700 MHz band could be released for mobile broadband use. The latest possible date for release is unclear, although we would note that the latest date at which existing DTT multiplex licences expire is in 2026. As such, there is in principle a wide range of possible release dates. On the other hand, if practical and international factors limited the range of possible release dates to a narrower window, this could reduce the potential benefits of running an incentive auction.

### **Socially optimal outcome**

A5.14 We would expect affected stakeholders to have better information than Ofcom about their valuation of earlier or later release dates. An efficient incentive auction would seek to fully reflect these valuations in determining the release date.

A5.15 However, the bidding behaviour of participants in an incentive auction would reflect only their private valuations, such as the costs to DTT of changing the transmission network, and the network cost savings available to MNOs. It would not reflect the broader social value of earlier or later release – including, for example, the effect on interleaved users of an earlier release, or the loss of benefits to consumers of mobile data services associated with a later release (including any effect on competition). Although it may be possible to design the auction in such a way that some of the social value is internalised this would complicate the auction process, or may not be achievable in practice.

A5.16 There is therefore a risk that the value *not* represented by auction participants could be systematically larger on one side than the other, e.g. total benefits from faster release for mobile broadband could exceed mobile operators' incremental profits by materially more than the total costs of faster release exceed those costs faced by DTT operators (or vice versa).

### **Scope for an appropriate auction design**

A5.17 An efficient incentive auction would be one in which the bids of incumbent licence holders and new users reflected their true valuations, and any 700 MHz release occurred at a time which maximised total value. However, obstacles may exist to designing such an auction.

A5.18 In particular, if we were to hold an incentive auction, all current licence holders would need to agree to relinquish their spectrum rights in the 700 MHz band by a specified date, for the spectrum to become available for mobile broadband use from that date. This is because the current licence holders do not use distinct sub-bands of the current DTT spectrum: each of the multiplexes is broadcast in different channels across this spectrum at different locations. This may have important implications for designing an incentive auction which correctly incentivises licence holders (i.e. which induces them to relinquish their spectrum licences by a given date, at a price which reflects the cost to them of doing so).

A5.19 The design of an incentive auction would also include a range of parameters which may have important implications for the stakeholders concerned, such as a default

date at which 700 MHz release will occur (with the incentive auction determining whether there is a net value to earlier / later release), and the pricing rules such as the relationship between amounts bid by new users of the 700 MHz band and incumbent licence holders and the payments they make or receive.

## Annex 6

# Glossary

**CEPT** - European Conference of Postal and Telecommunications Administrations

**DCMS** – The Department for Culture, Media and Sport

**DTT** - Digital Terrestrial Television

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

**DVB-T2**

An advanced digital terrestrial transmission technology developed by DVB. 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.

**FCC** – Federal Communications Commission

**GI spectrum** – Geographic Interleaved spectrum

**HD** - High Definition

A television or other video service with at least 720 lines of vertical resolution. This higher resolution picture raster can provide enhanced quality and more detailed pictures, particularly on larger displays.

**HEVC** – High Efficiency Video Coding

The newest video compression system which offers further efficiency improvements over MPEG-4.

**ITU** - International Telecommunications Union

Part of the United Nations with a membership of 193 countries and over 700 private-sector entities and academic institutions. ITU is headquartered in Geneva, Switzerland.

**LTE** – Long Term Evolution

**MHz** - Megahertz.

A unit of frequency of one million cycles per second.

**MNO** – Mobile Network Operator

**MPEG** - Moving Picture Experts Group

A body which develops technical standards for the compression of digital audio-visual content. Most UK standard definition digital television services use MPEG-2 video compression. The more recent MPEG-4 AVC (H.264) video compression offers greater efficiency than MPEG-2.

**Multiplex**

In digital TV broadcasting, a single 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.

**PMSE** - Programme Making and Special Events

A class of radio applications that support a wide range of activities in entertainment, broadcasting, news gathering and community events.

**PPDR** - Public Protection and Disaster Relief

**PSB** - Public Service Broadcasting or Public Service Broadcaster.

**SD** - Standard Definition

The lower, and currently most common, of the picture resolutions used for television broadcasting. Standard definition TV services in the UK and Europe have a vertical resolution of 576 (interlaced) lines.

**UHF** - Ultra-High Frequency

The frequency range from 300 MHz to 1000 MHz. Terrestrial TV broadcasting in the UK uses UHF frequencies between 470 MHz and 790 MHz.

**WRC** - ITU World Radiocommunication Conference

WRC reviews and revises the ITU Radio Regulations. Conferences are held every two to three years.

**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.