SRSP: The revised Framework for Spectrum Pricing

Proposals following a review of our policy and practice of setting spectrum fees

Consultation

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Contents

Section 1

Executive Summary

1.1 For over a decade, charges for many licences to use radio spectrum have been set by reference to the *value* of the spectrum as opposed to simply reflecting the *cost* of managing it. This document concerns the general principles and methodology that we use to set spectrum fees, known generically as 'spectrum pricing', including fees that reflect our costs. It will be of interest to the numerous commercial and public sector organisations throughout the economy that use, or wish to use, radio spectrum to provide a wide range of services.

1.2 The purpose of this document is to explain and to consult on how we propose to set spectrum charges in future. It is intended to clarify certain issues that stakeholders have raised with us, and to reduce uncertainty about the direction of future pricing policy. Some of the principles and practices discussed have evolved over time in relation to specific licence sectors and classes[1]. As a result not all of our principles or methodologies have been implemented, in full, for all licence sectors. We propose to continue to apply these refinements systematically in future and in a way that takes full account of the specific characteristics and circumstances of each sector.

1.3 This document is intended to be a guide to general principles and practice. As such, it does not make detailed fee proposals for individual sectors. We will consult further on fees in specific sectors as and when we consider it necessary to review these. When we do so, we will in all cases explain the various factors that we have taken into account in our proposals and, following consultation, the reasons for our decisions.

1.4 This document is supported by Appendix A (Our current practice for setting AIP fees) which is published as a separate document on our web-site[2] and which provides more detailed information on how we set fees on the basis of AIP currently.

The radio spectrum is a valuable resource and shortages are likely

1.5 The radio spectrum is a valuable resource that is used for a range of commercial and public services. Some frequencies are more valuable than others, for example because they are technically suitable for highly valued services like mobile broadband or broadcasting or because their use is harmonised internationally so equipment is more likely to be readily available and affordable.

1.6 The number of users that can be accommodated in a band is generally limited by the need to avoid harmful interference. Shortages will arise in parts of the radio spectrum and at geographical locations in which demand for spectrum exceeds its capacity. The use of scarce spectrum for one purpose or by one user will generally exclude or limit its use by others and so impose a cost on society in terms of the foregone benefits. In these circumstances, the mechanism by which spectrum is allocated and

[1] The term "licence sector" is used generically and may include a single licence class or a number of licence classes used by a group of users.
[2] http://www.ofcom.org.uk/consult/condocs/srsp/appendixA.pdf

assigned between different uses and users plays a key role in encouraging its optimal use.

Decisions by users are more likely to secure optimal use

1.7 As the independent regulator for communications, we have a duty to secure optimal use of the radio spectrum[3]. We interpret 'optimal use' to mean that the spectrum is used in a way that maximises the value that citizens and consumers derive from it, including broader social benefits, and taking into account the specific consumer and citizen interests, including the interests of particular groups within society, as set out in our statutory duties. We discuss this interpretation further in Section 2.

1.8 We believe that objective is, as a general rule, more likely to be achieved if detailed decisions on how spectrum is used are left to those directly engaged in its use rather than dictated centrally by a regulator. We have therefore adopted a range of complementary regulatory instruments to manage the spectrum with less central direction by Ofcom while recognising that regulation continues to play an important role in managing interference, negotiating international agreements to enable the better exploitation of the use of spectrum for the UK, securing compliance with international obligations and addressing market failures. These mechanisms include charging for radio spectrum at a level that provides incentives to promote its optimal use.

The role of pricing

1.9 Most licensed spectrum users pay annual fees. These, historically, were set to reflect spectrum management costs but gave little or no incentive to use scarce spectrum efficiently as the amount paid bore no relationship to the value of the spectrum held.

Administered incentive pricing

1.10 In the face of rising demand and emerging spectrum shortages, the pricing framework was changed in 1998[4] to allow fees to be set above the level needed to recover spectrum management costs with the important requirement that this should only be done with the aims of securing defined objectives. This is referred to as 'administered incentive pricing' (AIP) as fee levels are set administratively by reference to the regulator's estimate of the value of the spectrum rather than directly by the market as in an auction.

1.11 Since Ofcom was set up in 2003, we have continued to set AIP fees, within our framework of duties and objectives and have adopted it as one of our spectrum management tools. We have extended its application and further developed policy on where to apply AIP and how to set fees. AIP based fees are currently paid by the majority of spectrum users, in both the commercial and public sectors, for access to scarce spectrum that has not been auctioned.

[3] See section 3(2)(a) of the Communications Act 2003, which requires Ofcom to secure (among other things) in the carrying out of its functions, the "optimal use for wireless telegraphy of the electro-magnetic spectrum".
[4] The Wireless Telegraphy Act 1998 - since then replaced by the Wireless Telegraphy Act 2006.

1.12 AIP acts as a proxy for market prices for scarce spectrum that has been assigned administratively[5] rather than auctioned. It promotes optimal use by ensuring that users face a signal of opportunity cost[6] imposed on society by their use and therefore take it into account in their business and investment decisions, just as they do for other resources that they employ, and so have incentives to use it efficiently in the provision of downstream services.

Fees other than AIP fees

1.13 Where AIP is not justified, we set fees that reflect our spectrum management costs. We refer to this as 'cost-based pricing'. This applies where spectrum is not scarce or where fees based on the value of the spectrum would be lower than the relevant costs.

1.14 Alternatively, we may set a fee below a level that reflects our costs, including potentially setting no fee. We retain discretion to set low or zero fees in future fee reviews, in light of the circumstances. For example, for licence products known as "non-operational licences", which are available for test & development and academic research, fees are charged at a level specifically to encourage innovation.

1.15 We are not proposing any major review of cost-based fees, but would be interested to hear stakeholders' views on how they think we should set cost-based fees in future fee reviews, and in particular, on any particular factors they think we should take into account.

The effectiveness of AIP

1.16 A policy evaluation we published in 2009[7] reached the conclusion that it was too soon to expect AIP to have had a significant impact but that, in the main, it had met its primary objective of incentivising decisions that were more likely to lead to optimal use of the spectrum. We continue to view spectrum pricing as an important spectrum management tool and expect to continue to apply it where appropriate for the foreseeable future.

The role of AIP as a complement to other regulatory instruments

1.17 We have analysed the implications for pricing policy of the development of the spectrum market since trading was introduced at the end of 2004. In summary, we provisionally conclude that, in general:

- There is no single spectrum market but rather a set of separate markets[8] across the various frequency bands;

[5] That is assigned on a 'first come first served' basis, by comparative selection ('beauty contest') or reserved for the provision of public services.
[6] Opportunity cost is the value of alternative spectrum use forgone by society due to the current spectrum use.
[7] http://www.ofcom.org.uk/research/radiocomms/reports/policy_report/evaluation_report_AIP.pdf
[8] For ease of reference we have used the term 'market' as convenient shorthand and this is not intended to refer to a relevant economic market.

- Spectrum markets remain immature, with limited liquidity and an absence of developed market institutions and price information that would make them more effective;

- Trading and liberalisation alone may not be sufficient to promote efficient use in certain spectrum markets and so AIP may have a more important role in such markets;

- In markets where trading and liberalisation have a stronger role to play in the promotion of the efficient use of spectrum, the role of AIP may be less critical , but it still remains an important complementary incentive.

1.18 We conclude that AIP is a valuable complement to spectrum auctions, trading and liberalisation and can usefully reinforce incentives from trading. However, this general conclusion will need to be assessed on a licence sector-specific basis in future fee reviews.

We have reviewed our pricing principles and methodology and propose a number of enhancements

1.19 We have reviewed our general policy and methodology for setting AIP fees, including how we assess congestion, calculate reference rates and set fees for individual licences, and are now consulting on a number of clarifications and propositions on our pricing principles emerging from this work.

- We reaffirm *the purpose* of AIP is to help secure optimal use of the radio spectrum where spectrum is scarce, considering both frequency and geography, that its effects will usually occur over considerable periods given the long lifetime of much wireless equipment, and that spectrum congestion is a key indicator of whether it should be applied;

- We propose that we will continue to take account of *feasible alternative uses* of the spectrum as well as demand from the existing use in assessing the likelihood of current or future scarcity. This is an established principle that we propose to apply to those licence sectors for which it has not yet been implemented;

- We discuss the *relevant timeframe* over which we propose to take account in AIP of anticipated *changes in demand*, including from *alternative uses* that are feasible within that timeframe. We propose a case-by-case assessment of the relevant timeframe;

- We remain of the view that AIP fees are generally not an effective tool to take account of *wider social benefits or disbenefits* associated with activities using spectrum. It is generally more efficient and appropriate for the Government to apply targeted taxes or subsidies or to regulate the activity in question. We will consider the cases of individual uses specifically in any future fee review;

- We propose an increased focus on *relevant market prices* when setting fee reference rates although they will need to be used with caution. In consulting on future fee proposals, we will be explicit about whether and how we intend to use market information;

- We propose, *where licences are tradable*, to take account of the effectiveness of spectrum trading in the relevant spectrum and/or licence sectors, and other relevant factors in considering the role of AIP; and

- We propose to base *the trade-off between the risks of setting AIP fees too high and the risks of setting them too low* compared to the market value on the specific circumstances of the licence class or sector in question. When spectrum is tradable we will consider the extent to which trading is expected to promote optimal use, and will also have particular regard to the risk of undermining the development of secondary markets.

1.20 We propose to refine the *pricing methodology* that we currently apply in several sectors. At present, we set fees by reference to one 'fixed service' rate and one 'mobile service' rate, adjusted in certain cases. The main effects of our proposed changes would be:

- to track the variations in the value of spectrum between bands more precisely so that, for example, all current mobile bands[9] would no longer necessarily be priced on the same reference rate basis as each other and nor would all current fixed bands;

- in setting AIP fees for individual licences, to reassess each variable in our pricing algorithms to determine whether they are consistent with the principles in this document; and

- to continue to assess the impact of our fee proposals and amending them when required. This might affect decisions on timing or phasing and will need to be assessed on a case by case basis.

Future fee rate reviews and next steps

1.21 We are also consulting on how we should determine whether to conduct fee rate reviews in the future. Instead of planning to review all licence sectors periodically in accordance with a pre-arranged programme, we propose to consult on any need for fee reviews as part of our Annual Planning process.

1.22 We may still, however, on occasion need to undertake a fee review where there is a clear and urgent need to do so without including this in the Annual Plan.

1.23 In order to promote regulatory stability, we propose the principle that, normally, we would seek stakeholders' views on a proposal to review fees in the next year only if the evidence suggests that this would be justified, taking into account evidence of sufficiently material misalignment between the actual fees and the current value of the spectrum, or the cost of managing it, and other relevant factors.

1.24 We are seeking views from stakeholders on this revised approach, and also their views on whether there is a current need for any reviews of fee, based on our proposed criteria or on other criteria they propose. We specifically ask whether, as some stakeholders have represented to us, we should consider reviewing the fixed links fees as a priority. If as a result of the responses to this consultation we decide

[9] That is, those whose AIP fees are set by reference to the 'mobile' rate. This currently applies to, for example, Business Radio and Public Mobile Radio (cellular telephony) licences.

that this should be considered, we will include this in our proposed Annual Plan for 2011-12 and consult on its priority against our other spectrum management priorities.

Our key proposed principles and methodologies

1.25 The following table provides a summary of our key proposed principles and methodologies, indicating where in this document we present our rationale for these proposals.

Pricing principles and methodologies	Page Numbers
Proposed principle 1: role of AIP AIP should continue to be used in combination with other spectrum management tools, in both the commercial and the public sectors, with the objective of securing optimal use of the radio spectrum in the long term. AIP's role in securing optimal use is in providing long-term signals of the value of spectrum which can be indicated by its opportunity cost.	P. 27 - 28
Proposed principle 2: users can only respond in the long term The purpose of AIP is to secure the optimal use of spectrum in the long term, so as to allow users to be able to respond to AIP as part of their normal investment cycle. Even where users have constraints imposed on their use of spectrum, in general, some if not all users have some ability to respond to AIP.	P. 28 - 30
Proposed principle 3: when AIP should be applied AIP should apply to spectrum that is expected to be in excess demand from existing and/or feasible alternative use, in future, if cost-based fees were applied. In determining feasible alternative uses, we will consider the relevant timeframe, any national or international regulatory constraints, the existence of equipment standards, and the availability and cost of equipment.	P. 31 - 37
Proposed principle 4: the 'relevant timeframe' for AIP In general, we seek to assess excess demand, congestion and feasible alternative use over a timeframe that reflects the length of existing users' investment cycles.	P. 38 - 39
Proposed principle 5: AIP and spectrum trading Many secondary markets are unlikely to be sufficiently effective to promote the optimal use of the spectrum without the additional signal from AIP. Therefore AIP will likely continue to be needed to play a role complementary to spectrum trading for most licence sectors.	P. 40 - 42
Proposed principle 6: AIP and wider policy objectives Socially beneficial uses of spectrum do not, as a general rule, justify AIP fee concessions, because direct subsidies and/or regulatory tools other than AIP are normally more likely to be efficient and effective. For cost-based fees there might be some circumstances in which it could be appropriate to provide a concession.	P. 42 - 44
Proposed principle 7: AIP concessions and the promotion of innovation It will generally not be appropriate to provide AIP concessions in order to promote innovation. We may consider whether cost-based fees should be set at a lower level in order to promote innovation.	P. 44 - 45
Proposed principle 8: use of market valuations We will take account of observed market valuations from auctions and	P.45 - 47

trading alongside other evidence where available. However, such market valuations will be interpreted with care and not applied mechanically to set AIP fees.	
Proposed principle 9: setting AIP fees to take account of uncertainty Where there is uncertainty in our valuations and the likelihood of demand for feasible uses appearing we will consider the risks from setting fees too high, or too low, in light of the specific circumstances. When spectrum is tradable we will consider the extent to which trading is expected to promote optimal use, and will also have particular regard to the risk of undermining the development of secondary markets.	P.47 - 51
Proposed methodology 1: AIP and congestion In setting AIP fees, we will assess current and future congestion in existing use and demand for feasible alternative uses in the frequency band in question and at different geographic locations over the relevant timeframe, given technological, regulatory and international constraints and using readily available evidence.	P. 54 - 55
Proposed methodology 2: reference rates Reference rates will be based on the estimated value of the spectrum in the current use and any feasible alternative uses. These estimates will be informed, where appropriate, by the available market information (if any), and economic studies of spectrum value.	P. 55 - 57
Proposed methodology 3: calculating individual licence fees In converting reference rates to fees, we will take account of the value of the amount of spectrum denied to others. This will generally be based on frequency, geographical location, bandwidth, geographical coverage or other measure that reflects the geographical extent of co-ordination requirements, and in some cases the exclusivity of an assignment.	P. 57 - 59
Proposed methodology 4: impact assessments We will undertake Impact Assessments on our fee proposals to identify any potential detrimental impacts to spectrum users, consumers and citizens. We will need to consider carefully the balance of benefits and risks of the implementation of all changes in fees.	P.61 - 63

Other pricing related activities

1.26 We are currently undertaking a number of specific fee rate reviews and some stakeholders have asked us to clarify how this consultation relates to this separate series of consultations, particularly those for use of spectrum by the aeronautical and maritime sectors, but also other work we are undertaking in which fees are a core or key element.

1.27 This consultation proposes a framework for spectrum pricing that, subject to consultation, we expect to apply to all future fee rate reviews. It does not, however, apply this framework to any specific licence sector, nor propose any specific changes to fee rates. However, in developing the proposals for this framework we worked closely with the teams responsible for the specific aeronautical, maritime and PMSE proposals and therefore anticipate no inconsistency in the overall principles and methodologies incorporated in any of the proposals in the ongoing specific fee reviews.

1.28 Stakeholders should also note that the Government has recently laid a draft direction in Parliament which, if made, would require us to revise the level of annual licence fees applying to existing 900MHz and 1800MHz mobile licences to reflect the full market value of the frequencies in those bands. If the direction is made we would expect to consult, in due course, on our proposed approach to the implementation of this element of the direction.

1.29 We have also previously concluded that we will consult nearer the time on any fees that we propose for digital terrestrial broadcasting and will not implement these before the end of 2014, and that Ships' and Amateurs' licences will be free[10]. We do not intend this consultation to reopen either of these decisions.

[10] When applied for online.

Section 2

Introduction

The purpose of this consultation

2.1 This document consults on the overarching framework of policy principles and methodology that we will apply in setting fees for access to radio spectrum and on our approach to planning future reviews of fees in specific sectors. It is likely to be of interest to current and prospective users of the spectrum. This section sets out the context for this consultation and the basis of our analysis, including the legal framework.

2.2 We are publishing this document for consultation so that all stakeholders have an opportunity to consider our general approach, in the round, and we have the opportunity to consider responses from across all sectors before settling on any part of this approach.

2.3 The consultation proposes a general approach to considering fee policy, which is intended to accommodate all of the types of issue we need to consider in a specific fee policy and to ensure that these are all considered in future fee reviews. It effectively proposes a general set of questions that we will consider in every review. It does not propose that we will answer every question in the same way, in every future fee review. A key principle in this consultation is that there is no single way to answer these questions, because the circumstances of uses and spectrum bands are not all the same.

2.4 Any future fee review will be conducted under the general principles and methodology decided following this consultation. The detailed policy and fees in each case will reflect the specifics of the use(s) and band(s) under consideration.

The legal framework

2.5 The legal framework within which we operate is set out in the Communications Act 2003, the Wireless Telegraphy Act 2006 (the WT Act 2006) and applicable EU directives, including the Authorisation Directive and the Framework Directive.

Spectrum fees and our duties concerning spectrum management

2.6 We employ three mechanisms for setting fees for rights to use spectrum: cost-based pricing, AIP and auctions. This document focuses on the first two of these.

2.7 We apply AIP where appropriate to secure optimal use of the radio spectrum[11] and set fees for licences[12] and grants of recognised spectrum access (RSA) [13] with that

[11] Under Section 3(2)(a) of the Communications Act 2003 we have a duty to secure, among other things, the optimal use for wireless telegraphy of the electro-magnetic spectrum.
[12] Installation or use of radio equipment is unlawful unless under, and in accordance with, a licence granted by Ofcom (see s. 8(1) of the WT Act 2006). This does not apply to Crown bodies, which do not require a licence from us for their use of spectrum. However, the Secretary of State may make payments to Ofcom in respect of the use of spectrum by Crown bodies (s. 28 of the WT Act 2006).

objective in mind. The following section discusses our general approach to deciding when to apply AIP as opposed to charging cost-based fees. We explain in paragraphs 2.29 onwards below how we interpret 'optimal use'.

2.8 The Authorisation Directive[14] requires fees for rights to use spectrum to be objectively justified, transparent, non-discriminatory and proportionate. The WT Act 2006 permits us to recover sums greater than those necessary to recover the costs incurred in connection with our radio spectrum functions. If we do so, we are required to have regard in particular to:

- the extent to which the spectrum is available;
- present and likely future demand;
- the desirability of promoting:
  - efficient management and use of the spectrum;
  - economic and other benefits;
  - innovation; and
  - competition[15].

2.9 The fees for most licences are set out in specific regulations. The current regulations are the Wireless Telegraphy (Licence Charges) Regulations 2005 (SI 2005/1378), as amended.

2.10 The legal framework within which we operate may be subject to changes in the next 1-2 years deriving from the implementation of the new EU Framework for electronic communications networks and services[16] and/or the Digital Economy Bill if this becomes law.

2.11 Currently, however, it seems unlikely that there will be any changes to our high-level duty to secure the optimal use of spectrum, nor in our powers to set fees on which our proposals in this document are based. Once the nature and timing of any changes that affect our spectrum management functions are clearer, we will consider

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Additionally, a licence is not required also where the use of spectrum is exempted from this requirement by regulations. Equipment that is unlikely to cause interference, such as short-range devices or receivers, must be exempted from licensing under s. 8(4) of the WT Act 2006. Therefore, no fee is payable to access the spectrum by means of such equipment, unless under a grant of recognised spectrum access, as explained in the following footnote.

[13] Subject to Ofcom making the necessary regulations, Crown bodies and operators of equipment that can receive but not transmit (referred to as 'receive-only') may apply for recognised spectrum access if they wish their spectrum use to be formally recognised (see s. 18 of the WT Act 2006). Ofcom has a duty to take account of grants of RSA in the same way as of licences in carrying out its spectrum management functions (see s. 20 of the WT Act 2006). RSA has so far been introduced for receive-only radio telescopes in certain radio astronomy bands and for Crown bodies in the 406.1-430 MHz band.

[14] Article 13 of Directives 2002/20/EC, which also specifies that Member States shall take into account the objectives set out in Article 8 of Directive 2002/21/EC (the Framework Directive) in setting fees.

[15] Section 13 of the WT Act 2006.

[16] http://ec.europa.eu/information_society/policy/ecomm/tomorrow/index_en.htm

whether, and if so, how, we need to adjust our approach to spectrum pricing, in our subsequent Statement.

The radio spectrum and its value

2.12 Radio spectrum is a valuable resource. Television and radio broadcasting, mobile telephone networks, emergency services, radar and many other services and applications all depend on access to it[17].

2.13 The radio spectrum is finite in that use of spectrum for one purpose or by one user will generally exclude or limit its use by others. This means that use of spectrum imposes a cost on society where there is insufficient spectrum available to meet demand for it, whether for the existing or an alternative use. That cost is referred to as the 'opportunity cost'. It represents the value to society of the most valuable alternative use of the spectrum that is forgone and is a key concept in relation to spectrum pricing as explained below in paragraph 2.46 onwards.

2.14 Unless spectrum use is carefully managed and planned, it is highly likely that interference between different users will greatly diminish its value for communications and other purposes. This is the reason why the use of spectrum is coordinated between different services and different users nationally and internationally.

Spectrum value is influenced by its physical properties

2.15 Spectrum is not homogeneous. The laws of physics mean that different frequencies are more suitable for different applications depending on factors such as the distance the signals have to travel and the amount of information to be carried. Lower frequencies tend to travel further and penetrate buildings better than higher frequencies but have limited bandwidth that may not be sufficient for high-data uses. In addition, the relationship between size of antenna and frequency[18] means that lower frequencies may not be practical for some compact portable equipment, although again, technological solutions may be deployed extending the usable range of spectrum for this purpose.

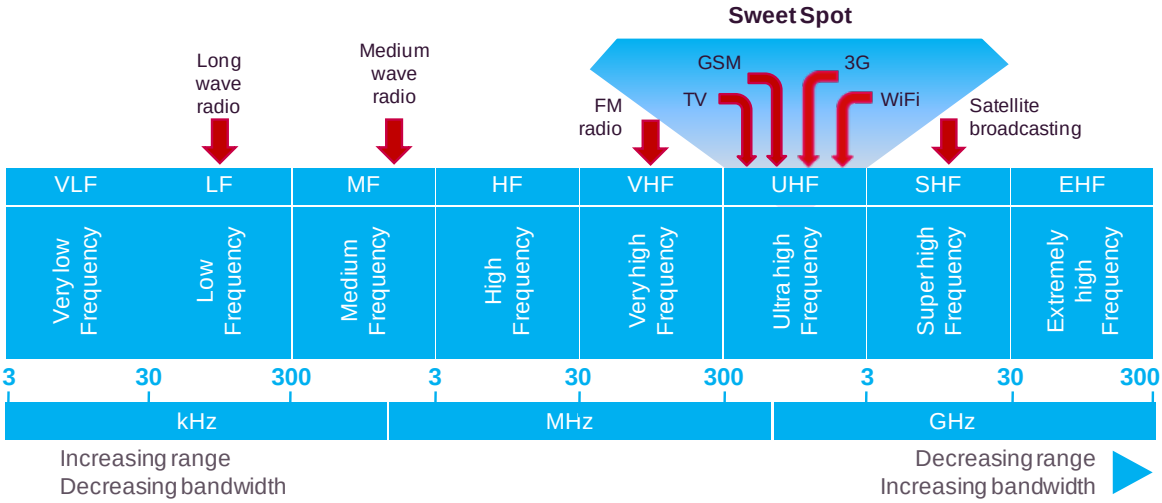
2.16 Conversely, higher frequencies can carry much more data although the suitability of frequencies much above 3 GHz for mobile applications depends on ongoing developments in technology (deployment in 4-5 GHz may become technically and economically feasible in the foreseeable future).

2.17 The figure below illustrates how the radio spectrum is used and shows the 'sweet spot' that is often considered the most attractive frequency range for commercial exploitation because it can be used for mobile applications and has sufficient capacity to carry broadband and video broadcasting. Everything else being equal, spectrum in the 'sweet spot' is likely to be in greater demand and therefore more valuable than other parts of the radio spectrum.

[17] Its use was estimated in 2006 to be worth about £40bn a year to the economy or about 3% of UK GDP. This estimate, which is now some years old, did not assess the size of those wider social benefits which are not captured in GDP measures: http://www.ofcom.org.uk/research/radiocomms/reports/economic_spectrum_use/

[18] In general, the lower the frequency, the larger the antenna needed. Frequencies around 100 MHz require antennas around half a metre long.

Figure 1: the spectrum 'sweet spot'



Spectrum value is affected by a range of factors

2.18 Spectrum value can however be significantly affected by factors other than intrinsic physical properties of propagation and bandwidth. These exogenous factors, illustrated in Figure 2 below, include the following.

- *International harmonisation.* The existence of international agreements to make spectrum available for particular services within Europe or globally, known as 'harmonisation', can create multinational markets for equipment and services including enabling roaming of consumer devices between countries. The resulting economies of scale in equipment manufacture may reduce the price of equipment and so tend to increase the value of the spectrum for downstream services. Harmonisation is often supported by substantial effort to design systems and develop technical standards and the time needed for this activity can be considerable. On the other hand, if harmonisation works as a constraint by being inflexible and reserving spectrum for services that are not commercially successful, or reserves more spectrum than the intended use requires, it can depress the value society gains from the spectrum by excluding higher value alternative uses.

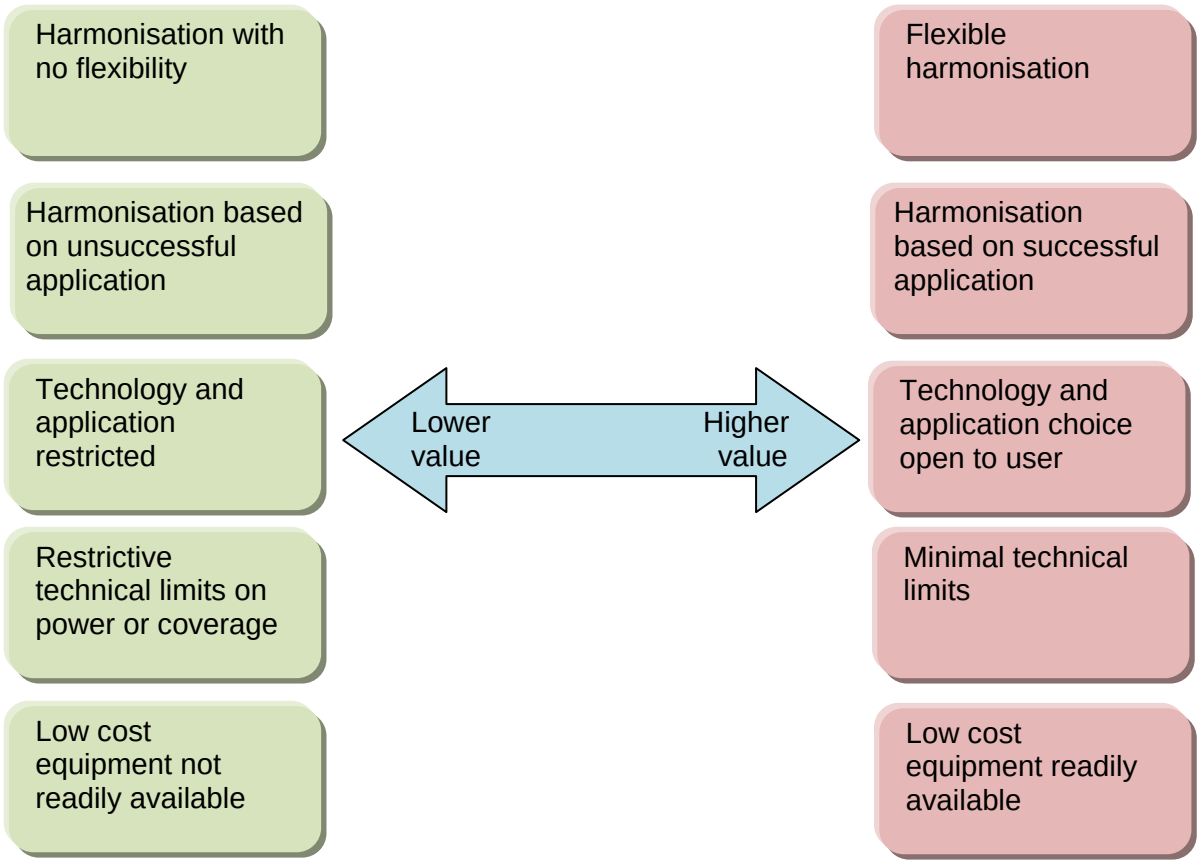
- *Demand from consumers/value of services to citizens.* The technological developments in recent years which have tended to enable uses like mobile broadband in more frequencies have been substantially driven by the observed high value placed on such services by consumers. As a result, the potential value of affected bands – both the value to individual consumers and the wider social value produced by the existence of these services – has increased. Similarly, developments in technology which allow more information to be transmitted for the purposes of national security or public safety have increased the benefits that society gains from the spectrum used in those services.

- *National frequency policy.* National restrictions on how spectrum may be used or licence conditions that effectively lock in current use can directly affect spectrum value. Parts of the spectrum may be reserved for particular services or technologies or for unspecified uses with a particular purpose, such as defence and national security. The need to protect other services from undue

interference may require us to impose technical restrictions, such as power limits on other users of spectrum. Such restrictions may be of value to the existing users because they provide added certainty about the condition of the spectrum that they access. However, if they inhibit or prevent user-led change, they may depress the value that society could gain from the spectrum over the long term. In general, in managing the spectrum, we aim to keep restrictions on use to the minimum necessary so as to minimise the risk that such costs will arise.

- *Availability of equipment.* If equipment is not readily available or is unduly expensive to purchase, this will make the spectrum less attractive for commercial or non-commercial services. Lead times for new technology can be considerable, especially if new technical standards need to be developed.

Figure 2: non-physical factors affecting potential value realised from spectrum



2.19 These factors are capable of being changed in the medium and long term but altering them may take considerable time or cost.

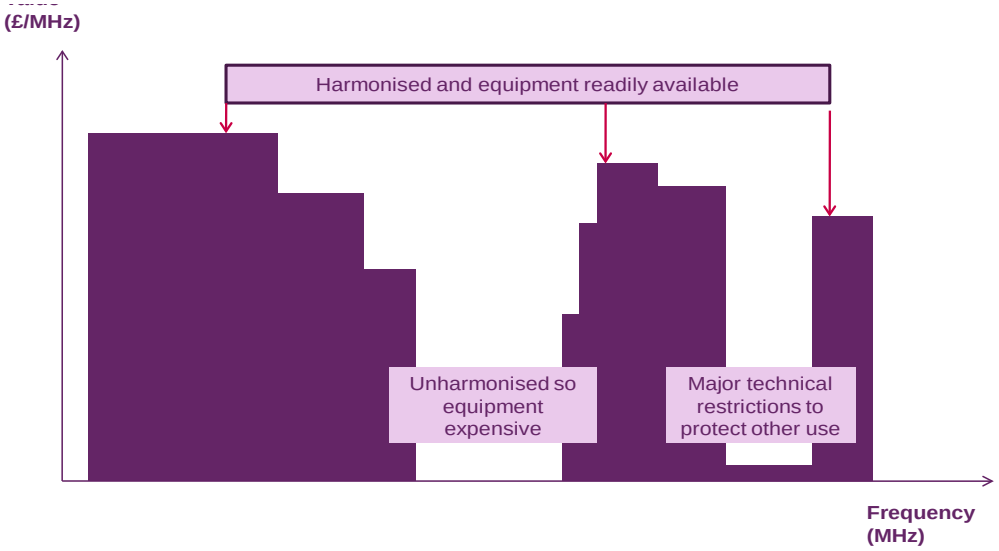
The spectrum frequency-value curve is likely to exhibit marked discontinuities

2.20 The value of spectrum may therefore be expected to vary considerably with frequency depending not just on its physical properties of bandwidth and propagation but also on factors such as those discussed above. Consequently, spectrum at one frequency will not necessarily be a substitute for spectrum at another frequency,

even if those frequencies are relatively close and have similar physical characteristics. The 'frequency-value' relationship will not follow a predictable, smoothly rising then falling curve that might be expected if value simply reflected the physics of radio propagation and bandwidth availability. Instead, the relationship can be expected to exhibit numerous discontinuities.

2.21 As discussed in following sections, this has important implications for how we charge for spectrum access. Although, as a rough guide, frequencies that are suitable for mobile services are likely to be more valuable than those that are not, the relationship between frequency and value is more complex as illustrated in Figure 3 below, and not all spectrum potentially usable by mobile applications is equally valuable for all uses. This illustrates how the value across a range of spectrum might vary with frequency.

Figure 3: illustrative spectrum values



Demand for radio spectrum is growing and shortages have been forecast

2.22 Demand for radio spectrum has grown substantially over the last decade driven by the rise in demand for mobile broadband communications and a range of other applications and certain frequency bands are already congested in some areas[19]. It was forecast by consultants in 2005[20] that demand will exceed supply by around 2.5 GHz below 15 GHz by 2025 and that spectrum shortages could constrain optimal deployment and growth in future; and a later study[21] found that growth in cellular and short-range wireless could generate significant pressure on spectrum over the next 3-4 years.

[19] The 165-173 MHz band even had to be closed to new business radio assignments in London in 1990 (i.e. before AIP was introduced) because it was too congested.
[20] *Spectrum Demand for Non-Government Services 2005-2025*, 1 September 2005 by Analysys and Mason, http://www.spectrumaudit.org.uk/pdf/spectrum_demand.pdf
[21] *Predicting Areas of Spectrum Shortage* by PA Consulting, 7 April 2009 at http://www.ofcom.org.uk/research/technology/research/spec_future/predicting/shortage.pdf

2.23 Such predictions, however, are subject to a number of caveats. Forecasts of demand looking much more than 5 years ahead are inevitably speculative as there is substantial uncertainty about the emergence of new technologies and consumer demand. In addition, new releases of spectrum and the fact that users' have incentives to deploy technologies that can make more use of what is available will both tend to counteract the simple effect of demand growth. However these changes are not continuous but themselves take time, during which high value spectrum may not be in sufficient supply to accommodate demand.

2.24 We intend to refresh our understanding of spectrum demand and expect to shortly commission a demand study that will provide an updated view of the current and potential future uses of spectrum. This study will undertake primary research to assess the likely demand for spectrum from existing and alternative uses and it is anticipated that this will form a key input to our spectrum management and pricing decisions.

Our approach to managing the radio spectrum

2.25 Faced with actual and potential spectrum shortfalls, we consider that the mechanism by which frequencies are allocated and assigned plays a key role in securing optimal use of spectrum. Changes in technology and also in consumer preferences either leading or responding to technological advances have become more frequent in recent years. As a result, it has become increasingly unlikely that any regulator can have sufficient information or foresight to predict which technology or service will generate greatest benefits for society. Moreover, regulation often takes a long time to change, and as a result cannot keep up with the pace of change.

2.26 Ofcom has progressively moved therefore from 'command and control', in which the regulator specifies, often in considerable detail, which technologies and services will access the spectrum, towards a more market-led approach, in which spectrum users are given greater flexibility to decide how best to use spectrum. We believe that allowing users to take decisions within an overall framework of appropriately liberalised regulation is more likely to secure optimal use of the radio spectrum over time. This is because users have better knowledge than the regulator of their own costs and consumer preferences and a strong incentive to respond to market signals, such as prices, to put resources to the best possible use.

2.27 AIP is one mechanism through which we can incentivise users to make better choices over the way in which they use spectrum. In our view, it is important to ensure that both public and private sector users face a price that reflects the opportunity cost of the spectrum they use, as they would in an auction or in an effective trading market. If spectrum is priced at a level which reflects its value to the best alternative users and uses, it is more likely be used productively and employed where it yields the largest possible benefit to society.

2.28 However, spectrum pricing remains only one of a range of regulatory instruments that we use to secure the optimal use of spectrum as we discuss further in 2.38 onward below.

What we mean by 'optimal use'

2.29 In response to requests by stakeholders, we have sought to clarify how we interpret our general duty to secure the optimal use of spectrum. In practice, we consider that

optimal use is more likely to be secured for society if spectrum is used efficiently, that is to produce the maximum benefits for society. We consider that efficient use of spectrum means that:

- spectrum is allocated and assigned to those uses and users that will provide the greatest benefits to society as a whole;
- individual spectrum users economise on their use of spectrum so there is no 'wasteful' use or underutilisation of spectrum; and
- spectrum becomes available over time for new and innovative services, where these are of sufficient value to society, and more generally to accommodate changes in technologies and consumer demand for services that rely on spectrum.

2.30 If these conditions are met, society will obtain the maximum possible output (measured by value) from the limited spectrum resource. The value that society derives from spectrum encompasses both the value that individual consumers gain from the goods or services that they obtain commercially and broader social, cultural or economic benefits.

2.31 In the commercial sector, the users and uses that can generate the greatest benefit to society are normally those who value spectrum more highly. The fact that they are prepared to pay the highest price for spectrum normally indicates their ability to use it more productively in order to satisfy commercial demand for downstream services. Consequently, their decisions are, in general, more likely to lead to highest benefits for society.

2.32 In the public sector, similar principles apply. The providers of public services buy their inputs such as property, energy, equipment and labour from markets, in competition with commercial operators. How much they are prepared to spend on particular inputs can be taken to indicate the amount of value they expect to generate for society from those inputs.

2.33 We discuss the particular case of broader social benefits which are not reflected in, or proportionate to, individual users' value of spectrum in Issue 6, from paragraph 3.82 to 3.91.

Exceptions where securing efficient use may not always be optimal

2.34 Given our belief that efficient use will promote maximum benefits for society from the use of spectrum, we aim to identify fee levels that will promote efficient use. However, we also need to consider the interests of particular groups in society, as set out in our general duties (and as required under our duty to conduct an Impact Assessment including an Equality Assessment). Put simply, if efficient use can only be secured at a significant cost to a particular group of citizens or consumers, then securing that increase might be efficient, but we would also need to consider whether this outcome would be optimal.

2.35 We therefore consider the potential impacts on particular groups of citizens and consumers before making fee proposals for consultation.

Our guiding principles for spectrum management

2.36 The *Spectrum Framework Review*[22] (SFR) set out some core principles that guide the way in which we seek to manage spectrum, as follows:

- spectrum should be free of technology and usage constraints as far as possible;
- it should be simple and transparent for licence holders to change the ownership and use of spectrum; and
- rights of spectrum users should be clearly defined and users should feel comfortable that they will not be changed without good cause.

2.37 We believe these principles remain valid.

We use AIP to complement our other regulatory instruments

2.38 We employ a number of complementary regulatory instruments to achieve our spectrum management objectives, key of which is to secure optimal use of the spectrum. These are:

- *liberalisation* – providing flexibility over the way in which spectrum can be used through the avoidance of unnecessary restrictions (e.g. in licence conditions), so that spectrum may more easily migrate to more valuable uses as these change over time;
- *spectrum trading* – allowing the rights to use spectrum to migrate to those that can generate greatest value, driven by the decisions of the users themselves rather the regulator;
- *auction, licensing and licence exemption* – auctions are used when awarding significant blocks of sought-after spectrum so as to put spectrum licences into the hands of those that value them most (licence exemption and first-come-first-served licensing are alternative means of releasing spectrum in other circumstances);
- *administered incentive pricing (AIP)*[23] – providing incentives to use scarce spectrum more efficiently by setting licence fees that reflect the value of the spectrum to other uses and users, and that may be higher than the costs incurred in managing the spectrum; and
- *regulatory intervention* – direct actions to achieve specific changes in the use of spectrum (e.g. clearing a band of current use as with the current 800 MHz clearance work).

2.39 Taken together, these instruments constitute what we refer to as a “market-led” or “user-led” approach to spectrum management:

[22] http://www.ofcom.org.uk/consult/condocs/sfr/sfr/
[23] The terminology reflects the fact that licence fees are set *administratively* by Ofcom rather than directly by the market as in an auction.

- Spectrum auctions and spectrum trading are market based approaches, driving the primary and secondary markets respectively;

- Liberalisation is a complementary deregulatory measure which, amongst other things, creates more flexibility for these market based approaches to function;

- Meanwhile, the incentivising nature of AIP, which is intended to reflect market value, is consistent with the idea that, when adequately informed, it is best for the decisions of users themselves to drive the way that spectrum is used; and

- Whilst the use of regulatory intervention seems least compatible with a market based approach, the case for an intervention is likely to be triggered by the need to address market failures (e.g. coordination challenges), deal with interference (which is an externality in market terminology) or ensure compliance with international obligations. Moreover, the threshold for intervention is set high, in that the cost benefits case should be clear and persuasive, and should outweigh the risk of regulatory failure, with any decision to intervene being consulted upon.

2.40 As noted above, the initial assignment of licences may be done by auction or administrative procedures. Auctioning licences on a technology and usage-neutral basis ensures that spectrum is, at least initially, employed where it yields the greatest value to society. In consequence, our current policy is not to charge AIP during the initial term of an auctioned licence, but we might, where appropriate, apply AIP in future after the expiry of the initial term. The main role for AIP therefore relates to licences which have been assigned administratively, including on a first come first served basis, and this observation applies whether or not these licences are tradable. We discuss the complementary roles of trading and AIP in Section 3, and Annex 6.

2.41 Whether and how we apply AIP will depend on the circumstances of the frequency band in question and our judgement of which regulatory instrument or combination of them will be most effective.

History and experience of AIP in the UK

2.42 Fees have been charged for rights to use radio spectrum in the UK since 1904[24]. Until 1998, they were set in line with the general rule that charges by public sector bodies for statutory functions should be no higher than necessary to recover their costs.

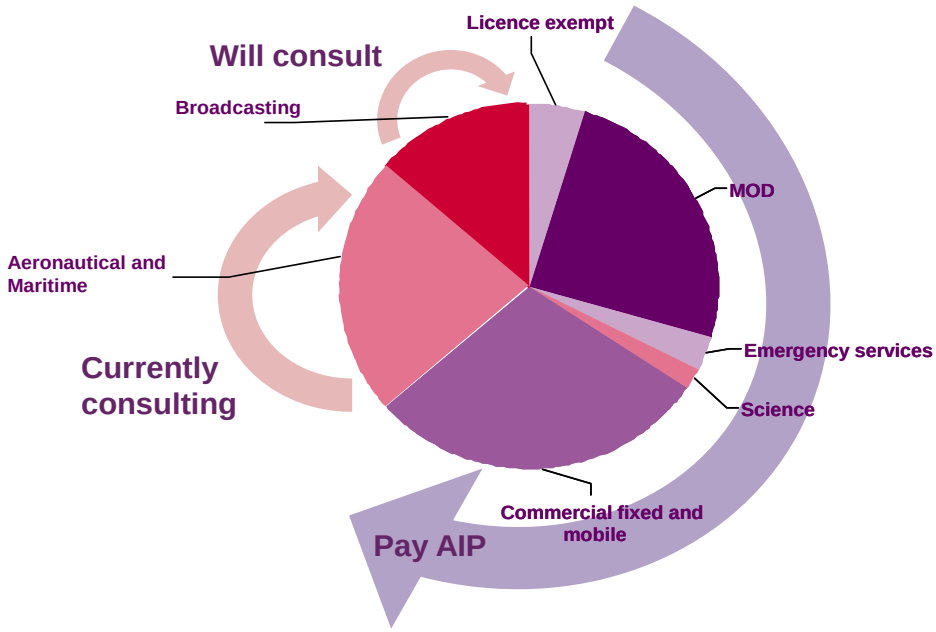
2.43 However, burgeoning use of wireless communications was resulting in substantial increases in demand for spectrum. Growing spectrum shortages in certain frequency bands and geographical areas were posing a serious threat to continued innovation, competition and growth. In response to this, Parliament made a fundamental change to the way in which spectrum fees were set. The Wireless Telegraphy Act 1998[25]empowered the Radiocommunications Agency (the RA) to auction licences and to set fees above cost-recovery levels in order to help manage the radio spectrum in the best interests of society.

[24] Section 1(6) of the Wireless Telegraphy Act 1904.
[25] Now consolidated in the Wireless Telegraphy Act 2006.

2.44 We took over the RA's spectrum management functions in 2003 and have continued to use and develop AIP. In addition, we have extended the range of spectrum management tools by introducing spectrum trading and making grants of RSA. As illustrated in

2.45 Figure 4 , AIP now applies to a large number of classes of licence and RSA.

Figure 4: Application of AIP across different spectrum users[26],[27]



The purpose of and rationale for AIP

2.46 The purpose of AIP is to provide a sustained long-term signal to users of value of the spectrum that they occupy and to give them incentives to use it in a way that maximises the benefits for society over time.

2.47 The rationale for AIP may be simply stated. If the price charged for any limited resource, whether it is energy, raw materials, land or spectrum, does not reflect its value, there will be less incentive to use it efficiently, it will be not be available for alternative uses or other users that could produce additional value and society will be worse off. For example, faced with a choice between investing in more advanced equipment and using more spectrum, businesses will naturally tend to choose the

[26] Bandwidth is weighted according to frequency to provide comparability between the amounts of spectrum allocated at different frequencies. At lower (typically more valuable) frequencies a smaller amount of spectrum is available compared to at higher frequencies so that a 1 MHz assigned at 100 MHz represents a similar percentage of available spectrum to 10 MHz assigned at 1 GHz.

[27] Following a consultation, we have previously confirmed that we will not implement fees for spectrum licences used for DTT or DAB before the end of 2014; we will consult nearer that time on any fees we propose. http://www.ofcom.org.uk/consult/condocs/futurepricing/statement/. Any consultation will also take into account all relevant aspects of the proposed digital radio upgrade, which may affect the timing of any proposed fee changes for digital radio multiplex licences. Further information can be found at http://www.culture.gov.uk/what_we_do/broadcasting/5631.aspx , Section 3b.

option with lower costs. If spectrum appears cheaper because the fee does not reflect its true value, businesses will rationally use more spectrum in preference to more advanced equipment As a result, society may be worse off if higher value uses or additional or more efficient users are denied access to spectrum.

2.48 Users face various choices in relation to spectrum. These include:

- *whether to use radio* or some other form of technology such as cable, where this would be possible;
- *which frequency band to use.* For example, for point-to-point fixed links, there might be a choice between using a lower frequency, which requires fewer links to cover the distance but possibly denies spectrum to a higher value use or user, and using a higher frequency requiring more infrastructure investment (where this is practically feasible) but imposing a lower opportunity cost;
- *which radio technology to employ.* For example, it might be possible to reduce the spectrum bandwidth needed to carry a given amount of information by investing in more sophisticated modulation or coding schemes;
- *what network architecture to employ.* For example, to accommodate a given level of traffic in a cellular network, there are trade-offs between the number of base stations and the amount of spectrum used. Installing more base stations requires additional investment in equipment but enables spectrum to be re-used more intensively so that more traffic may be accommodated in a given bandwidth.

2.49 Users may, in addition or instead, choose to make adjustments to other elements of their business or service, for example by reducing non-spectrum costs.

2.50 We recognise that some of these choices might be constrained in practice, for example by regulatory requirements, equipment availability or the need to re-equip; and that the time needed to respond to price signals might be lengthy if significant investment is required to upgrade or replace existing systems. AIP is therefore intended to provide an incentive for longer term investment decisions, recognising that choices may be limited in the short to medium term. We discuss this further in the following section.

2.51 However, subject to these caveats, we would expect, and experience tends to confirm, that spectrum, like other finite resources, is likely to be used sub-optimally over time if those making decisions on its use do not face a price to use it that reflects its value to society.

Setting fees to reflect opportunity cost provides the right incentives to maximise benefits for society

2.52 In general terms, benefits to society will be maximised over time if spectrum is priced to reflect opportunity cost. The opportunity cost is the price that would emerge in a well functioning market and reflects the value of spectrum to the best alternative use

or user that is denied access to it[28]. When AIP fees are charged, users will hold scarce spectrum if they value it more than the AIP fee. If AIP fees reflect opportunity costs, users have an incentive to only use spectrum that they value as highly as the best alternative user or use. In this way, AIP fees have an effect similar to the prices that would emerge in a well functioning spectrum market.

2.53 One user's use of spectrum may deny another's use in two ways[29]:

i) Transmissions may 'sterilise' an area around the site because the emitted signals swamp reception of incoming signals from other transmitters;

ii) It might also be necessary to exclude other transmitters from an area around the system receiver in order to prevent harmful interference to reception[30].

2.54 In either case, our duty to secure optimal use would lead us not to permit some users access to the affected spectrum, where the existence of harmful interference[31] would rule out efficient use by one or more users.

2.55 In deciding to apply AIP, we do not claim to be able to predict exactly how users will respond to a particular level of fees. Over time, users can be expected to adapt their use of spectrum and other inputs and the services they offer in response to a wide range of factors that it is not possible to predict with any certainty. By charging users amounts that correspond to the value of spectrum, AIP incentivises them to use it efficiently.

2.56 This assumption that individual users will, if given suitable incentives, make decisions appropriate to their circumstances that are optimal for society, is fundamental to our spectrum management framework. In setting AIP we are not making any explicit or implicit assumption about how current or future users should use spectrum. It is neither feasible nor necessary for us to predict exactly how spectrum users will respond.

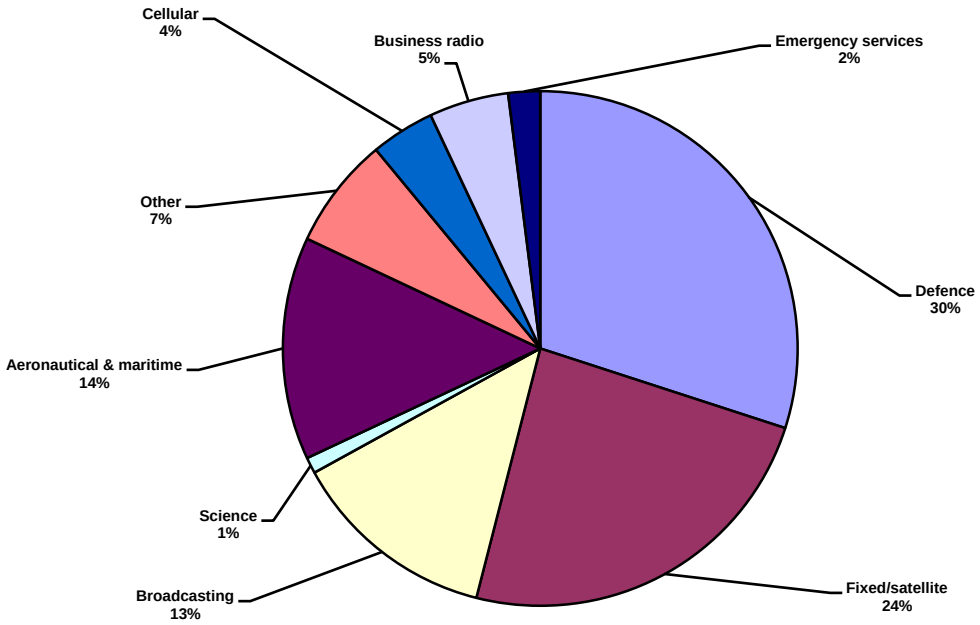
Application of spectrum pricing in the public sector

2.57 As shown in Figure 5, below, the Ministry of Defence (MoD) a Crown Body[32], is a major user of spectrum, holding around 30% of the spectrum[33]. It is therefore

[28] Even if the band is already allocated to the highest value use, there will still be an opportunity cost if prospective users are denied access. In that case, the opportunity cost would correspond to the benefits that those users would have generated had they been able to access spectrum.
[29] For a fuller discussion of interference and how it arises, see our June 2008 *Guide to Spectrum Usage Rights* at http://www.ofcom.org.uk/radiocomms/isu/sursguide/.
[30] The exclusion might extend beyond the frequencies assigned to the system (so-called 'out-of-band' protection), possibly extending hundreds of MHz beyond the designated frequency limits of the assignment if receivers are insufficiently selective resulting in 'guard bands' larger than strictly necessary.
[31] In some uses, users can tolerate higher levels of interference and so it is possible to make more assignments in a given portion of spectrum. Interference that users tolerate is not considered 'harmful'. Everything else being equal, a licence for this sort of use would be expected to have a lower opportunity cost, because the denial effects on other users are reduced.
[32] There is no general legal definition of a Crown body but central government departments reporting to ministers such as the MoD, Home Office and Treasury are generally considered to be Crown bodies.

important that Crown Bodies, as well as commercial users, have effective incentives to use spectrum efficiently[34].

Figure 5: weighted use of spectrum below 60 GHz[35]



2.58 Ofcom cannot require the Crown to pay licence fees for the use of spectrum as Crown bodies, such as the MoD and some other government departments and agencies, do not need a licence to use spectrum.

2.59 The *Independent Audit of Spectrum Holdings* recommended that the public sector, including the Crown, should face the same incentives and signals as private sector users of spectrum. This principle, and the explicit principle that pricing for public sector spectrum should be set on a comparable basis to the private sector, was adopted by the Government in its response[36].

2.60 Any future fee reviews that follow this consultation will therefore have implications for the amounts paid by the Crown.

2.61 Other public bodies that are not Crown bodies require a licence from Ofcom in the same way that commercial users and pay licence fees set by Ofcom. They will therefore be directly affected by the general principles set out in this document.

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[33] Although MoD has permitted access to parts of the spectrum it holds for other public sector (such as the emergency services) and commercial use, much of which access is managed and charged for by Ofcom through WT Act licences.

[34] Non-military 'Aeronautical & maritime' users are generally commercial but were included in the *Independent Audit* as 'public sector' reflecting the extensive public policy (safety) interest and regulatory involvement in their use of wireless communications, and the fact that many technologies and spectrum bands are shared with defence uses.

[35] Bandwidth is weighted according to frequency to provide comparability between the amounts of spectrum allocated at different frequencies. At lower (typically more valuable) frequencies a smaller amount of spectrum is available compared to at higher frequencies so that a 1 MHz assigned at 100 MHz represents a similar percentage of available spectrum to 10 MHz assigned at 1 GHz.

[36] www.spectrumaudit.org.uk

Policy review and assessment: does AIP work?

2.62 In June 2009, we published a policy evaluation report on AIP[37]. This used the following evaluation criteria; has AIP:

- facilitated the allocation of spectrum into optimal use over time?
- disrupted the optimal use of spectrum, for example by causing spectrum to remain unused despite being in demand?

2.63 After examining the available evidence, this report:

- concluded that, in the main, AIP has helped incentivise spectrum users to consider more carefully the value of the spectrum they use and to take decisions that are more likely to lead to optimal use of available spectrum;
- identified cases in which AIP has plausibly promoted more efficient use of spectrum; and
- found no evidence that AIP has had material adverse consequences.

2.64 The report was subject to two important qualifications that the effects of AIP:

- cannot easily be quantified in isolation and it is difficult to infer from the available evidence how matters would have been different in the absence of AIP; and
- can only realistically be assessed over periods that may be as long as 15-20 years because of the lifetime of installed systems and infrastructure.

2.65 The report accordingly concluded that it will be necessary to keep the effectiveness of AIP under review.

Other pricing related activities

2.66 We are currently undertaking a number of specific fee rate reviews and some stakeholders have asked us to clarify how this consultation relates to this separate series of consultations, particularly those for use of spectrum by the aeronautical and maritime sectors, but also other work we are undertaking in which fees are a core or key element.

2.67 This consultation proposes a framework for spectrum pricing that, subject to consultation, we expect to apply to all future fee rate reviews, but does not propose any specific changes to fee rates. The aeronautical and maritime fee reviews make detailed proposals for fee rate changes, specific to those uses and users. In developing the proposals for this framework we worked closely with the teams responsible for the specific aeronautical and maritime proposals, as well as the PMSE proposals and therefore anticipate no inconsistency in the overall principles and methodologies incorporated in any of the proposals.

2.68 Stakeholders should also note that the Government has recently laid a draft direction in Parliament which, if made, would require us to revise the level of annual licence

[37] http://www.ofcom.org.uk/research/radiocomms/reports/policy_report/evaluation_report_AIP.pdf

fees applying to existing 900MHz and 1800MHz mobile licences to reflect the full market value of the frequencies in those bands. If the direction is made we would expect to consult, in due course, on our proposed approach to the implementation of this element of the direction.

2.69 We have also previously concluded that we will consult nearer the time on any fees that we propose for digital terrestrial broadcasting and will not implement these before the end of 2014[38] and that Ships' and Amateurs' licences will be free[39]. We do not intend this consultation to reopen either of these decisions.

2.70 We have also consulted on the extension of AIP to the PMSE sector, and are also consulting on extending it to the aviation and maritime sectors[40].

The structure of this document

2.71 The rest of this document is structured as follows:

- Section 3 sets out our proposed core policy principles in relation to AIP;
- Section 4 sets out our proposed methodology for setting spectrum fees;
- Section 5 sets out our proposed plans for conducting specific fee rate reviews;
- Annexes 1-3 explain our consultation principles and how to respond to this consultation;
- Annex 4 sets out the consultation questions;
- Annex 5 describes the consultancy reports that have informed our thinking;
- Annex 6 sets out our experience of spectrum trading to date, and more detail on our rationale for a continuing role for AIP when licences are tradable;
- Annex 7 discusses our current approach to reference rates and the implication on the so called "cliff-edge";
- Annex 8 provides a qualitative assessment of the impact of our proposals on fixed links and business radio;
- Annex 9 provides a glossary.

[38] Following a consultation, we have previously confirmed that we will not implement fees for spectrum licences used for DTT or DAB before the end of 2014; we will consult nearer that time on any fees we propose. http://www.ofcom.org.uk/consult/condocs/futurepricing/statement/. Any consultation will also take into account all relevant aspects of the proposed digital radio upgrade, which may affect the timing of any proposed fee changes for digital radio multiplex licences. Further information can be found at http://www.culture.gov.uk/what_we_do/broadcasting/5631.aspx , Section 3b.

[39] When applied for online.

[40] http://www.ofcom.org.uk/consult/condocs/spectrum_pricing/
http://www.ofcom.org.uk/consult/condocs/aip_maritime/

2.72 A separate Appendix, Appendix A, is available on our web-site[41] and sets out a more detailed description of how we have applied our methodology to setting AIP fees, through a series of case studies.

[41] http://www.ofcom.org.uk/consult/condocs/srsp/appendixA.pdf

Section 3

Core pricing policy principles

3.1 We believe that AIP continues to be a useful tool to help secure optimal use of the radio spectrum. This Section sets out and clarifies the core principles that we propose to employ in deciding whether to apply AIP to particular licence sectors, as well as how we should value spectrum. It addresses specific issues raised with us by stakeholders at workshops we held before publishing this document. Section 4 discusses our general methodology for deciding how much to charge for individual assignments of spectrum, where the licences may be held by many different users divided by channel or by location.

3.2 These principles and methodologies, modified as appropriate in the light of responses to this consultation, will inform how we propose to set licence fees in future. We would welcome feedback on our proposals or suggestions for other matters that it would be useful for us to clarify.

3.3 Most of the principles discussed in this section are already applied to all licence sectors while others represent refinements and clarifications that we are proposing in the light of experience of AIP to date. We propose to apply these principles to all future fee reviews, while recognising that we need to take account of the particular circumstances of the particular frequency bands and licence types under review and this might require us to modify them in particular cases. We will consult on how to take account of the specific circumstances and give reasons for our decisions, when we carry-out future licence sector-specific fee reviews.

3.4 The remainder of this sections considers in turn:

- Our impact assessment of our proposals;
- The role of AIP – what it is trying to achieve?
- Why does AIP need to be a long term signal?
- When should we apply AIP?
- What does long-term means in practice?
- Is AIP needed for tradable licences?
- Should AIP be set at a level to promote wider social benefits?
- Should we use AIP to promote innovation?
- Should we make greater use of market valuations in setting fees?
- How should we account for uncertainty in market values when setting fees?

3.5 When we make specific fee proposals it will also be necessary to undertake an impact assessment of the fee levels implied by these principles (as revised in light of this consultation). Such an impact assessment may therefore lead us to revise our

proposals to address specific issues identified by this assessment. Our proposals on the ways in which we might address issues identified in such impact assessments are provided in Section 4.

3.6 Annex 5 summarises various research and other reports that have informed our thinking on spectrum pricing.

Impact Assessment

3.7 Impact Assessments (IAs) provide a valuable way of assessing different options for regulation and showing why the preferred option was chosen. They form part of best practice in policy-making. This is reflected in Section 7 of the Communications Act 2003, which states that we generally have to carry out IAs where our proposals would be likely to have a significant effect on businesses or the general public or when there is a major change in Ofcom's activities. As a matter of policy, Ofcom is committed to carrying out and publishing impact assessments in relation to the great majority of our policy decisions. For further information about our approach to IAs, see the guidelines *Better Policy-Making: Ofcom's Approach to Impact Assessment* at http://www.ofcom.org.uk/consult/policy_making/guidelines.pdf.

3.8 The analysis presented in this document constitutes an IA for our proposals to refine our spectrum pricing policy and methodology. Because it outlines a general approach rather than specific fee proposals, it is not possible to provide quantitative estimates of its effects: these will be included in the IAs that we will produce when consulting in due course on specific fee revision proposals. Those IAs will include our best estimates on the available information of the financial and commercial implications of our proposals for current users and their customers. Meanwhile, in order to help inform stakeholders' responses to this consultation, Annex 8 contains a series of qualitative illustrations of the possible effect of applying our proposed general principles and methodology to specific sectors.

3.9 As part of our Impact Assessments we conduct an Equality Impact Assessment to identify whether our proposals would have particular effects on specific groups within society. We have therefore considered whether we were required to undertake a full Equality Impact Assessment for this review. On the basis of our Initial Equality Impact Assessment Screening we determined that this was not required, because our proposed changes to our pricing methodology do not raise specific equality issues; they will affect spectrum users, consumers and citizens equally, regardless of race, gender or disability. As we are not making proposals to change any specific fees, at this stage, there would be no immediate impacts, and so no impacts that we would need to consider for potential differential effects between groups. Equality Impact Assessments will form an integral part of any future fees review.

Issue 1: what is the role of AIP?

3.10 AIP's role is to help secure the optimal use of spectrum by providing a sustained long-term signal of spectrum value to inform users' investment decisions (both new users and existing users) for spectrum that is scarce.

3.11 Following on from the discussion in Section 2, overall, we believe that there remains a robust theoretical basis for AIP and credible empirical evidence that it is effective in practice and has not caused any significant detriment.

3.12 We propose therefore that we should, where appropriate, continue to use AIP as one element of our spectrum management approach.

3.13 We expect in future to propose AIP-based fees, for consultation, where our analysis of the evidence indicates that this is more likely to promote the optimal use of spectrum than the alternatives of charging cost-based fees or no fee.

Proposed principle 2: role of AIP
AIP should continue to be used in combination with other spectrum management tools, in both the commercial and the public sectors, with the objective of securing optimal use of the radio spectrum in the long term. AIP's role in securing optimal use is in providing long-term signals of the value of spectrum which can be indicated by its opportunity cost.

Issue 2: why does AIP need to be a long-term signal?

3.14 In issue 1 we state that we consider that AIP's role in securing optimal use is in providing a sustained long-term signal to promote optimal spectrum use over time. In this section, we consider why this signal should be a long-term, and what long-term means.

3.15 In addition, some stakeholders have argued that it is unreasonable to apply AIP if users would find it difficult, in practice, to respond to price signals, particularly where this is as a result of constraints imposed on them by other non-spectrum related regulation.

3.16 In the following paragraphs we address each of these issues in turn.

It takes time to change use

3.17 We recognise that the nature of spectrum use often means that users are unable to respond in the short or medium term. There are typically three broad types of limitations on spectrum users' ability to change:

- the existence of durable industry or band-specific equipment, which means that there are costs to ceasing to use a band early, particularly if the equipment characteristics do not allow its use by other services or in other bands;
- the time required to invest in new equipment or technology in order to move to other bands, use less spectrum or provide new or more valuable services over the band;
- the existence of contractual commitments.

3.18 Spectrum is generally used in combination with infrastructure of various types, for example networks of transmitters and receivers and consumer terminal equipment, that normally have a lifetime of many years and that cannot easily and quickly be re-tuned to different frequencies. These assets may take considerable time and effort to change and involve substantial investment by service providers and consumers. Lead times for innovation, from developing new technical standards through equipment design to manufacture and installation, may be considerable and extend to decades for major infrastructure.

3.19 Consequently, once a business has invested in wireless equipment, it will likely be tied to the use of a specified bandwidth at particular locations for the lifetime of that equipment and unable to respond to AIP signals much earlier than that, especially if this involves substantial infrastructure investment or there is a substantial consumer base for the existing service.

3.20 The question arises as to whether Ofcom should apply AIP when such barriers prevent users from altering their spectrum usage within a certain timeframe, and what that timeframe is. In the short to medium term, for instance, users may be unable to move to less congested frequencies or invest in spectrum-efficient technology.

3.21 Our use of AIP is intended to create continuing, long-term incentives for the efficient use of spectrum, and not just to encourage efficiency in the short term. We fully expect that many of the efficiency gains from AIP will come in the form of long-term investment decisions.

3.22 In our view, technological and contractual barriers to change will mostly diminish over time. The range of responses open to users will generally increase over time as transmitters, receivers and other equipment falls due to be replaced and investment decisions are newly considered. Similarly, contractual commitments currently preventing changes in use will expire at some point, or the user will be able to transfer the associated obligations without penalty.

Non-spectrum management related regulatory constraints do not always eliminate opportunities for users to respond to price signals

3.23 Some users may be constrained in making a choice to reduce or change their spectrum use because of external non-spectrum management related regulations that require them to use particular equipment, or a particular piece of spectrum. Where this is the case, we need to take this into account and consider whether it reduces or even removes the scope for a price signal to improve the efficiency with which the spectrum is used.

3.24 Any such assessment needs to be case by case, not least because non-spectrum management related regulations are each tailored to secure the specific policy objectives relevant to that sector, so they will all be different. However, in general, such constraints fall into two types and have corresponding effects on the ability of users to respond to a price signal:

- Some regulations (‘output specifications’) require the use of wireless technology to deliver certain capabilities, but do not specify bands or standards except broadly. Therefore, for example, a requirement on an important infrastructure installation (a power plant, or power distribution network) to maintain a standard of wireless communication to allow for response to certain events, may leave the choice of equipment and of spectrum used up to the individual user. As a result, provided there is a range of substitutable spectrum available, subject to the market and technology constraints above, users may respond efficiently to a price signal;

- Some regulations (‘spectrum specifications’) specify in detail the types and standards of technology (which will determine bandwidth requirements, for example, and possibly choices between bands). Some go further and specify the

bands that the equipment must operate in. In such cases, the only flexibility available to users is to change or reduce their use of existing spectrum, possibly with an accompanying change or reduction in operations supported by that radio spectrum use. In the case of spectrum that is congested in the current use, such that other users may make use of spectrum released, or where it is feasible for alternative uses to access this spectrum, then this response from some users can lead to overall improvements in the efficiency with which the spectrum is used, although we will need to consider the potential for changes to be disruptive for consumers and citizens[42].

3.25 In the longer term, there may be scope for the non-spectrum management regulations to be modified, increasing the range of responses available to individual users.

3.26 In exceptional cases, regulations not only specify in detail the spectrum and technology to be used, but may even rule out marginal reductions in use such as using fewer transmitters. In such cases, in the short term users' only flexibility to respond to a fee increase will be non-spectrum responses: to absorb costs by making savings on other inputs, to pass on costs where possible, or to reduce output at the margin.

3.27 Depending on the circumstances, any of these responses might be efficient if the spectrum is used for higher value users and uses over time. However, these responses might also be inefficient and disruptive to the benefits for society provided using the spectrum.

3.28 As for all cases where there is a risk of disruptive impacts, we would need to give this careful consideration and would need to consult with the relevant stakeholders (in this case, including advice and input from the relevant regulators) before determining the right way forward on specific fee proposals.

3.29 In general, AIP is set to influence decisions over a reasonably long period (the 'relevant timeframe') and most users will be able to respond to AIP in ways that lead to more efficient use of spectrum. There may be cases where extraneous regulation, or other factors, are so constrained in their framing that users cannot change their use of spectrum. However, even in these cases it is necessary for us to consider the specifics of each case before determining that AIP has no role to play, if there is excess demand for the spectrum.

Proposed principle 2: users can only respond in the long term
The purpose of AIP is to secure the optimal use of spectrum in the long term, so as to allow users to be able to respond to AIP as part of their normal investment cycle. Even where users have constraints imposed on their use of spectrum, in general, some if not all users have some ability to respond to AIP.

[42] In cases where there is neither congestion in the current use, nor demand from feasible alternative uses, we would not expect to be applying AIP in any case.

Issue 3: when should we apply AIP?

3.30 AIP is potentially applicable:

- to WT Act licences that have not been auctioned, whether or not those licences are tradable or liberalised and whether or not the licensee belongs to the public or commercial sector;
- where appropriate, after their initial licence term, to licences that have been auctioned;
- to grants of RSA, whether or not those grants are tradable or liberalised; and
- indirectly, to Crown bodies, including the Ministry of Defence, that, in line with government policy, pay for spectrum on a comparable basis to commercial users.

3.31 Deciding whether and when to apply AIP depends on assessing the circumstances of the spectrum concerned, and of current and potential users.

3.32 The prospect of current or expected future[43] excess demand in a band is central to our decision to charge AIP-based fees and to setting those fees. It indicates that there is a risk that potentially higher value users and uses could be denied access to spectrum; and more generally, that the current use imposes an opportunity cost on society.

3.33 If sufficient spectrum is available to meet current and expected future demand at a cost-based level of fee, there will generally be no spectrum management need to set fees above the level needed to reflect our spectrum management costs.

3.34 In assessing the balance between supply and demand for a particular frequency band and location, we need to take account of:

- demand for spectrum from the existing uses of the band over the 'relevant timeframe', which is discussed under Issue 4 below;
- demand for spectrum from *feasible alternative* uses over the relevant timeframe, taking into account relevant constraints as discussed below.

[43] We make a forward-looking assessment of spectrum availability and demand, as required by Section 3 of the WT Act 2006, in order to ensure that AIP provides a suitably long-term signal to inform future decisions on investment and spectrum use.

Terminology

3.35 In this consultation document, we define the concepts of 'excess demand', 'scarcity' and 'congestion' as follows:

- Spectrum is in 'excess demand', or said to be 'scarce', where demand by existing and alternative users *at a cost-based fee*[44] would exceed the capacity of the band and location in question (the available supply);

- 'Congestion' refers to the level of utilisation the existing user(s) make of a specific band (and location) given the current level of fee. More generally, it relates to the difficulty that is experienced in making new or revised assignments in a band (or location). Unlike the existence of excess demand, congestion is a matter of degree. Some bands and locations have only low congestion and it is relatively easy to authorise new users. Others have high levels of congestion and it is difficult to accommodate new users without packing them so closely that harmful interference is likely. Between these two extremes are bands or locations with medium congestion.

Demand needs to be assessed in the future as well as now

3.36 As a matter of good spectrum management, it is desirable to take account of anticipated future demand as well as current levels of demand[45]. This is for the following reasons:

- AIP is intended to provide a long-term signal of spectrum value in order to influence decisions on spectrum use over time. The timescale over which AIP is likely to need to operate, in view of the factors discussed below, may be considerable:

  - The electronic communications sector is characterised by dynamic change. It will help to avoid abrupt and potentially detrimental shifts in pricing if we anticipate developments by taking a view of future demand based on factors such as past assignment trends, current ease of making assignments and evidence of future market and technology developments;

  - Because of long lead times for infrastructure investment, investment decisions made now will affect spectrum demand for a considerable time into the future. Without forward-looking price signals, by the time that heavy congestion is manifest, the existing demand may well be further locked in, spectrum shortages will persist and the opportunity cost on society will be larger than it would otherwise have been.

[44] The minimum fee we generally charge for spectrum fees is a cost-based fee. As such in order to determine whether, absent AIP, the spectrum would be scarce, we need to consider the demand that would exist at this cost-based fee.

[45] This principle of spectrum management is reflected in our statutory duty, under the WT Act 2006, to have regard to "the demand that is likely to arise in future for the use of the spectrum for wireless telegraphy". WT Act, Section 3(1)(c)
http://www.opsi.gov.uk/RevisedStatutes/Acts/ukpga/2006/cukpga_20060036_en_1

Spectrum congestion in existing use is a key indicator of the need to apply AIP

3.37 In principle, AIP should only be charged in those bands and locations in which there would be insufficient spectrum available to meet current or anticipated demand if AIP was not applied and users paid cost-based fees instead. However, for spectrum that is currently subject to AIP, we will not normally know the impact on the demand for a band and location if we applied a cost-based fee rather than AIP. This is because demand for spectrum will be affected by the current level of the fee. We therefore propose to continue using the level of congestion in a band/location at the current price as an indicator of excess demand. Congestion is an observable phenomenon that indicates how much available capacity is in use.

3.38 In most cases, a high level of congestion in the current use or uses (where spectrum is shared) at the current fee level is a strong indicator that AIP is required in the band, before considering the demand from feasible alternative uses. AIP might also be called for in bands/locations that are not currently highly congested but in which high demand growth, at current prices, is expected within the relevant timeframe, or if users have not yet had time to migrate to the band in response to AIP signals in other bands. Conversely, AIP might not be required, or might be reduced, in bands/locations that are currently congested, if demand is expected to diminish or if additional substitutable spectrum is expected to become available.

3.39 The appropriate way to assess congestion will depend on the nature of the use. We discuss our current approach for different types of licence in a separate Appendix A that supports this consultation document. Where assignments are exclusive, an important indicator of congestion in the existing use is the number of assignments in relation to the existing capacity in the band and location. This indicates how near the band/location is to being 'full' at the current fee levels. For assignments which are shared, such as some Business Radio licence types, the appropriate measurement may be the channel loading.

3.40 However, in heavily co-ordinated environments, particularly where the use of highly directional antenna permits extensive frequency re-use dependent on the specific technical characteristics of the assignments already in use it can be very difficult, if not impossible to calculate what the capacity of a band might be. This applies, for example, in bands allocated to fixed links, or shared by fixed links and satellite earth stations. A more subjective, but pragmatic measure of congestion is the degree of (present or expected) difficulty in meeting demand for new assignments with the desired 'spectrum quality' characteristics[46]. Even if it is possible to make new assignments by packing them more closely in the band with less frequency or geographical separation between adjacent assignments, this would increase the level of interference or reduce service availability to an extent that it could fail to meet users' requirements in terms of reliability or other service quality measure.

[46] These broadly denote the suitability of an assignment for the use in question. The critical aspects of quality will depend on the nature of the service but include, for example, the level of interference from neighbouring assignments or the proportion of time that communication is disrupted by adverse weather conditions ('availability'). Some frequencies are more susceptible to rainfall than others.

Current use can impose an opportunity costs on society if it denies access to spectrum for feasible alternative uses

3.41 As noted above, if there is current or expected congestion in the existing use, it is likely that AIP would help to promote efficient use of the spectrum in that band/location over time.

3.42 In addition, in assessing demand for spectrum, we propose to take account of demand from feasible alternative uses as well as demand from the existing service.

3.43 Alternative use can be:

- capable of co-existing with the use under consideration; or
- incompatible with the existing use(s) and require the existing use(s) to be cleared from the band (or portion of the band) before it can be deployed.

3.44 Excess demand from alternative uses is unlikely to be apparent to existing users, where such feasible use is not currently permitted. However, if demand from such alternative services exists, there will be a non-zero opportunity cost, which may be substantial, associated with the current use. In that case, it is also likely that AIP would help to promote efficient use over time.

3.45 In identifying the feasible alternative uses, we propose to take account of various factors, including the physical properties of the band and its suitability for other applications/services, evidence of national and international regulatory constraints that may restrict the alternative uses that may be permitted in the band, the existence (or active development) of equipment standards and the availability and cost of equipment as discussed in the following paragraphs.

The effect of national regulatory constraints on feasible alternative uses

3.46 In determining what alternative uses (both compatible and incompatible) could feasibly use the spectrum, it is necessary to consider whether there are any national regulations or policy that might prevent such alternative use in practice.

3.47 National regulation or policy might impose constraints that inhibit or prevent alternative uses of particular spectrum. In line with our liberalisation policy, we aim to minimise restrictions on use to the minimum necessary for spectrum management purposes. However, spectrum management and compliance with international co-ordination agreements, for example, will mean we need to exclude certain uses, or types of use, from particular spectrum.

3.48 For example, in order to ensure that UK use in a band does not cause interference to uses in neighbouring countries in contravention of a co-ordination agreement, we may need to limit the power levels for UK use, or exclude users from some areas of the country, or both. Such exclusion would have the effect of making certain alternative uses unfeasible, because their requirements could not be met within those restrictions. If we did not foresee the removal of these restrictions within the relevant timeframe, those alternative uses should be ignored in assessing demand for the spectrum.

3.49 Within the UK, we sometimes need to exclude or limit users in one band in order to protect use in another, nearby band. As above, such a restriction would have the effect of making some alternative uses technologically unfeasible.

The effect of international constraints on spectrum on feasible alternative uses

3.50 Similarly, there may be international constraints on how the frequency band is used. In earlier consultations[47] and workshops, stakeholders have suggested that alternative uses should be ignored when spectrum has been exclusively allocated by an international agreement to the existing use; and that AIP-based fees would not then be appropriate because the opportunity cost was zero. We discuss this somewhat complex issue in more detail in the following sub-section.

3.51 Similarly to the effect of national constraints, the effect of exclusions at the international level is to rule out alternative uses, to a greater or lesser degree. In considering which uses are ruled out, and for how long (i.e. whether for the whole of the relevant timeframe or a shorter period), we need to identify the type of the constraint.

3.52 There are three broad types of international agreement relating to spectrum use. It is important to distinguish between them as they do not all constrain alternative uses:

- *Flexible harmonisation of radio spectrum*: many harmonisation measures are non-exclusive in that they allocate spectrum to a number of services on a Primary basis. EU harmonisation measures can also be flexible in that they require spectrum to be "made available" without requiring it to be denied to alternative uses or technologies. This is due to an increasing appreciation of the benefits of more flexible harmonisation that is technology and application neutral;

- *Exclusive harmonisation of radio spectrum*: harmonisation[48] that reserves a band exclusively for a specific application, sector or technological standard to the exclusion of others[49];

- *International co-ordination and Treaty obligations:* agreements that may typically require us to exclude uses in order to protect uses in neighbouring countries, but potentially over a wider geographical area. International co-ordination issues have already been discussed above as they are factored into our planning and

[47] For a recent example, see *Applying Spectrum Pricing to the Maritime Sector, and New Arrangements for the Management of Spectrum Used for Radar and Aeronautical Navigation Aids. A Second Consultation* (2009), Section 5. Available at: http://www.ofcom.org.uk/consult/condocs/aip_maritime/aipcondoc.pdf

[48] Harmonisation is the identification and allocation of common frequency bands throughout a region (e.g. Europe) or globally under the International Telecommunication Union (ITU) for a particular radiocommunications service and in some cases a specific technical standard. Harmonisation involves identifying spectrum for a particular service (or group of services) within each signatory country and may be mandatory, as in the case of many EU Directives or Decisions, or non-mandatory, as in the case of recommendations of the Conference of European Posts and Telecommunications (CEPT).

[49] Section 4.8 of our *Spectrum Framework Review* (2005) explains our position on exclusive access agreements. Ofcom does not generally support these as they narrow the range of competing demands for the spectrum and risk trapping it in less valuable uses. For instance, spectrum that has been exclusively allocated to a particular service or technology will, in effect, be sterilised if the harmonised application fails to become commercially viable.

co-ordination approach. However, there are also a small number of International Treaty obligations that place additional and sometimes onerous limitations on the use of spectrum in UK, some of which arise directly from the regulation of radio use[50] and some that arise in relation to other regulatory regimes[51].

3.53 With all international agreements when considering the feasibility of alternative uses it is important to consider the specific constraints on the use of the spectrum in the UK that these agreements impose. For example, an exclusive allocation at the ITU level would only constrain the use of spectrum within the UK to the extent that any alternative use would be required to protect neighbouring countries' use of the spectrum[52]. Conversely, some agreements, including actions by the EU to exclusively harmonise spectrum impose such strict constraints on use that no feasible alternative use is possible.

3.54 It is therefore important to understand the legal constraints any international agreement imposes and also, often more importantly, the inherent technical limitations that such agreements impose on the use of the spectrum in UK when deciding what feasible alternative use is possible. It may often still be possible under many agreements for the UK to make valuable use of the spectrum whilst respecting the need to abide by our obligations under such agreements.

3.55 However, in the following sections, we discuss the general implications of the broad types of international agreements identified above.

3.56 Flexible harmonisation agreements generally allow national spectrum authorities considerable flexibility with respect to alternative use and technology. We have discussed previously in more detail the range and effect of these different types of agreements in considering our overall spectrum management approach[53]. In the majority of cases, changing the use of bands subject to such agreements would require appropriate consultation within the UK, but would not require re-negotiation of international agreements. As a result, we would not consider that alternative uses were unfeasible over the relevant timeframe because of such agreements. Indeed, if the international agreement is non-mandatory or allows other uses, AIP can facilitate change to a higher value use or more efficient technology.

3.57 Exclusive harmonisation agreements, such as exclusive allocation in the radio regulations, can still permit some valuable alternative uses of the spectrum in UK. In such cases, some alternative uses would be feasible and we should take these into account when setting fees. There are only some specific exclusive harmonisation agreements and some International Treaty obligations that mandate exclusive access to a specified use or sector and/or technology to the exclusion of all other uses in the UK. In such cases, while the exclusive harmonisation agreement applies, AIP would not enable the benefits of a change of use to be realised even if incumbents reduced their existing use as we would not be able to permit an alternative use to access the spectrum released.

[50] Most onerously perhaps RR footnote 5.340 that prohibits any emissions in a band to which it is applied.
[51] E.g. Safety of life regulation in the maritime sector.
[52] Where such use is in conformance with the Radio Regulations.
[53] *Spectrum Framework Review* (2005), Section 2.5.
http://www.ofcom.org.uk/consult/condocs/sfr/sfr/sfr_statement

3.58 If such an exclusive harmonisation agreement is likely to apply for all of the relevant timeframe, therefore, no alternative uses would be considered feasible.

3.59 In cases where there are no feasible alternative uses within the relevant timeframe, however, AIP can still be useful to incentivise re-allocation of spectrum within the existing use where there is excess demand for that use. If the band is congested in its current use or likely to become so within the relevant timeframe, we would expect to set AIP fees on the basis of our assessment of the value of the spectrum in existing use only.

Effect of the availability of equipment and standards on feasible alternative use

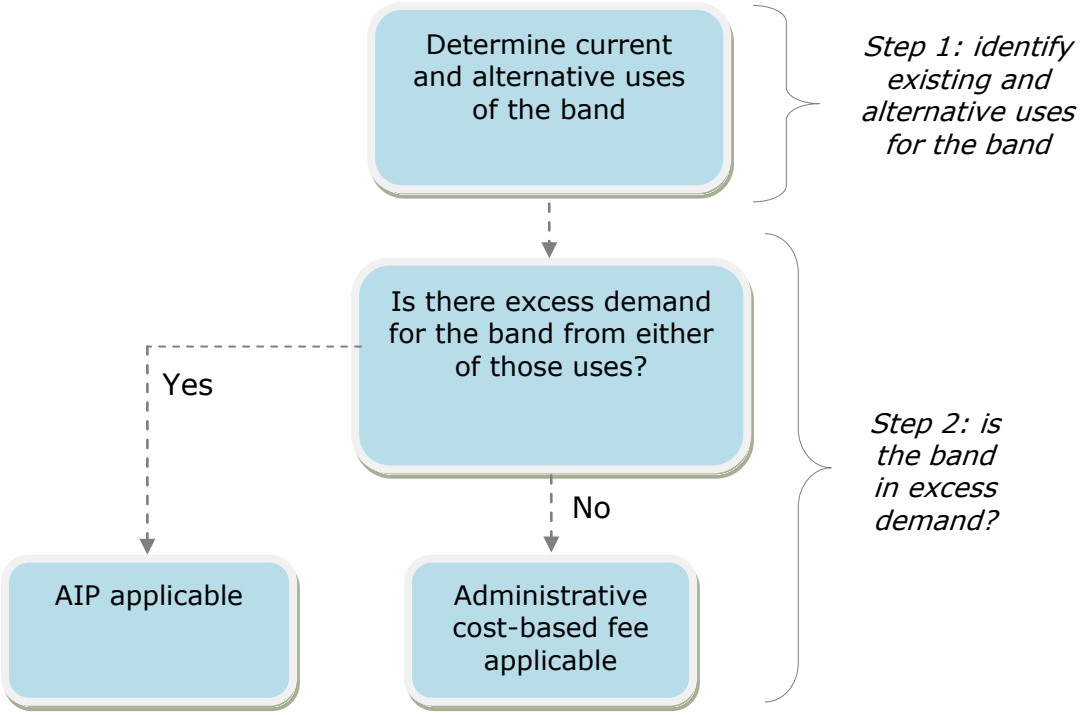
3.60 In considering whether alternative uses should be taken into account when deciding whether to apply AIP or not, and at what level, we also need to consider potential users' ability to purchase equipment at a reasonable cost, in the relevant timeframe, as this will have a significant impact on the demand from the alternative use. It is also necessary to consider, over the relevant timeframe whether standards for such equipment are likely to be developed for the band, if not currently available.

3.61 Where equipment and standards do not exist and are unlikely to be developed over the relevant timescale then such alternative use should not be considered feasible. However, if there is the potential for such standards to be developed – or where it requires only minimal changes to existing standards and equipment already freely available, then such alternative use should be considered feasible but any implied value of the spectrum in this use would need to be assessed taking into account the fact that the availability of equipment is not certain at the present time. How we take account of this explained in Issue 9.

Proposed principle 3: when AIP should be applied
AIP should apply to spectrum that is expected to be in excess demand from existing and/or feasible alternative use, in future, if cost-based fees were applied. In determining *feasible* alternative uses, we will consider the relevant timeframe, any national or international regulatory constraints, the existence of equipment standards, and the availability and cost of equipment.

3.62 Figure 6 below illustrates the application of our analysis of Issues 1 and 3.

Figure 6: Steps in setting AIP spectrum fees



Issue 4: what is "long-term" or the relevant timeframe?

3.63 As discussed in Issues 1 and 2, above, it is important to set our decisions relating to AIP within the context of the "relevant timeframe". These decisions include the timeframe over which to:

- interpret references to the 'long-term' and 'short-term'. For example, if the relevant timeframe is 2 years, long-term is 2 years, whereas if the relevant timeframe is 10 years, 2 years would be considered short to medium-term;
- consider the feasibility of an alternative use being able to use a frequency band.

Forecasting uncertainty and the relevant timeframe

3.64 In making decisions on AIP, we believe that it is important to ensure that we consider a timeframe that matches the frequency with which users in a band make investment decisions. This reflects the fact that AIP is intended to provide a long-term signal of the value of spectrum. In this context, if users are contemplating investing in band-specific equipment with a lifetime of 20 years, then the relevant question is: is the band likely to be scarce and therefore valuable over the next 20 years? If this is likely to be the case, then AIP should be set to ensure that users take into account the fact that this use of the spectrum will exclude other valuable users or uses in future, when making such investment decisions.

3.65 If the timeframe used to assess congestion is too short relative to users' investment cycles, we risk failing to secure the optimal use of spectrum for the following reasons:

- We might fail to take account of longer term developments in technology or markets and so innovative applications may be delayed or denied access to spectrum;
- We might provide price signals that encourage users to invest in equipment in spectrum bands that could become more valuable in the longer term than they would value it themselves. At this time we would have two choices:
  - to increase fee levels to reflect the increased value – which might result in some users needing to abandon the spectrum and stranding assets; or
  - leaving fee levels at the existing levels and locking out higher value uses or users.
- Both of these options would lead to an inefficient outcome and therefore it is important to ensure that signals are provided over the appropriate timeframe compared to the investment cycles of existing users.

3.66 Signalling our expectation of likely congestion from existing use or demand from alternative use on a similar timescale to users' investment decisions will tend to give existing users sufficient time to adjust their spectrum use. This will allow them to take the increasing or decreasing value of spectrum into account in the normal planning processes, that is, without having to write off their investments more quickly than is economically efficient. It also allows society to benefit by enabling demand from higher value users and uses to be met as and when it arises, while avoiding disruption to existing services. For example, when radio equipment comes up for renewal, users can decide whether to move to a higher, less valuable (and therefore lower priced) frequency band, if this meets their needs, rather than continue to operate at a frequency that might be becoming increasing valuable due to the potential for higher value uses being able to use it.

3.67 We would not normally expect to look beyond the average lifetime of equipment and, in practice, may be limited by our ability to forecast demand, particularly from alternative uses. Equipment lifetimes can be 15 to 20 years or longer for large-scale infrastructure investments. However predicting future demand for the spectrum will inevitably be uncertain and in many cases we will be unable to predict with any confidence beyond a five to ten year horizon, except for example where the use of spectrum involves the need for co-ordinated long-term planning amongst users. In practice, our ability to assess future demand will depend on the degree of market and technological uncertainty, and we will take this into account in our assessment of likely future congestion.

Proposed principle 4: the 'relevant timeframe' for AIP
In general, we seek to assess excess demand, congestion and feasible alternative use over a timeframe that reflects the length of existing users' investment cycles.

Issue 5: is AIP necessary for licences that are tradable and liberalised?

3.68 Stakeholders have asked whether it is necessary or justified to charge AIP if spectrum licences are tradable. Both spectrum trading and AIP are intended to encourage users to make efficient use of spectrum. There is an argument that, once trading is possible, Ofcom should dispense with AIP since the ability to sell spectrum for a price that exceeds the value to the current holder should provide sufficient incentives to achieve efficient use.

3.69 This is an issue that we considered in our statement of 6 August 2004 on *Spectrum Trading*[54]. We concluded that AIP should continue to apply after spectrum trading and liberalisation had been introduced. We were concerned that trading alone, while an important aid to optimal use, might not be fully effective at promoting efficiency in the early stages of development of the trading market.

3.70 Spectrum trading has now been in place for over 5 years and we have taken the opportunity to revisit that conclusion. We set out our preliminary views below. Annex 6 sets out our analysis in more detail.

Extent of trading in the UK to date

3.71 To date, fixed links, business radio, fixed wireless access, spectrum access licences and certain RSA grants are tradable. Although trading volumes have increased from a low base, turnover is limited within tradable licence classes.

3.72 There has been considerable debate in the UK and elsewhere about the reasons for the observed levels of trading. It is difficult to draw inferences about the effectiveness of the trading market from the volume of trades alone. For example, existing assignments might be close to optimal, or the market may not have achieved its full potential due to the existence of barriers to trading or other factors.

3.73 The fundamental question, irrespective of recently observed trading volumes, is whether the secondary market is sufficiently effective to enable us to reduce the need for AIP. We discuss this in the following paragraphs.

We consider that AIP still has a role in relation to tradable spectrum – but we will review case-by-case

3.74 As described in more detail Annex 6, spectrum is not homogeneous. Spectrum at one frequency may not be a substitute for spectrum at another frequency and the spectrum value curve exhibits numerous discontinuities. As a result, the market for spectrum needs to be considered not as a single market but as a series of fragmented and discrete 'sub-markets[55]' across various substitutable frequency bands.

3.75 Trading volumes and market liquidity in individual sub-markets have not yet enabled the development of market institutions that would facilitate low-cost, efficient trading activity, such as spectrum brokers or other market intermediaries. There is some

[54] http://www.ofcom.org.uk/consult/condocs/spec_trad/statement/ page 40 onwards.
[55] For ease of reference we have used the term 'market' as convenient shorthand and this is not intended to refer to a relevant economic market.

evidence that they are beginning to emerge in the USA but they have yet to gain a foothold here. For the most part, trading continues to be mostly bilateral and traders must find each other via private contacts, advertising or other ad hoc means. In addition, market price information is virtually non-existent outside the small number of auctions held to date. As a result, transaction costs may be too high and may be deterring efficient trades.

3.76 Transaction costs are also increased due to licence conditions that enable fragmented and highly technically co-ordinated sharing of spectrum e.g. fixed links. In these sub-markets, a large number of existing assignments each have a relatively localised coverage area. A potential buyer may not be able to secure the spectrum rights needed for his service by a single licence trade but may need to locate, and buy a number, and potentially a large number, of licences. The cost may make it unfeasible or uneconomic to acquire licensed access to the entire geographical areas or of subsets of the band through the market. In such circumstances, licence conditions can lock-in historical uses and trading may be less effective. AIP might then have a correspondingly greater role to play.

3.77 This highlights that the way in which a frequency band is currently planned and assigned by us might also make it difficult in practice for either trading or pricing to enable a higher value use or more efficient technology to be deployed, if that change would require the effective 'clearing' of a band or part of a band.

3.78 This may be so even if the change would generate substantial additional value for society and realise large gains for the parties. If the new use requires a contiguous block of spectrum over a regional or national area, AIP and other market mechanisms may in some circumstances be less effective than direct intervention by us. However, before we would consider such intervention we would need to have a high level of certainty of the level of increased benefit to citizens and consumers that would result from such an intervention.

3.79 We also note that some commercial and public spectrum users may be less responsive to trading than to AIP. This may be the case, for example, where public sector users are unable to retain the proceeds from spectrum sales. More generally, when strong pressures are put on managers to reduce or contain their operating budgets, but less importance is placed on realising untapped revenue sources such as might arise from selling spectrum, AIP can provide a more powerful incentive for licensees to use spectrum efficiently than the possibility of selling unwanted spectrum.

3.80 There may be other reasons, specific to an individual licence sector, which means that trading is not yet, and may not be in future, effective. We discuss in more detail in Annex 6 possible reasons why trading may not have yet reached its full potential in some spectrum markets, and further, why in some markets that potential may be inherently limited.

3.81 All of the above discussion suggests that it is likely to be premature to dispense with AIP as a complementary tool for securing optimal use of spectrum. We therefore think that, for the present at least, while spectrum trading is proving useful and effective for growing numbers of spectrum users, spectrum trading markets are not sufficiently effective, as a general rule, to supplant AIP in promoting optimal use. Consequently, we consider that in most circumstances AIP will continue to be needed in those bands where there is excess demand, even if licences are tradable.

We propose to assess the roles of trading and AIP for each licence sector-specific fee review in order to reach a decision appropriate to the circumstances of the individual market.

Proposed principle 5: AIP and spectrum trading
Many secondary markets are unlikely to be sufficiently effective to promote the optimal use of the spectrum without the additional signal from AIP. Therefore AIP will likely continue to be needed to play a role complementary to spectrum trading for most licence sectors.

Issue 6: should AIP fees be set at a level that promotes wider policy objectives?

3.82 Stakeholders have asked us to explain how, in setting AIP fees, we take account of the wider value to society of particular uses of spectrum[56]. This raises the more general question of whether, in setting AIP, we should encourage particular uses of spectrum in order to secure particular policy objectives, including the mitigation of disbenefits, as well as to secure identified benefits from use. For example, fees might be discounted for particular uses that are considered to generate particular social benefits.

3.83 By way of background, we recall that, as discussed in the preceding section, it is generally desirable that spectrum users face, and pay, fees that reflect the opportunity cost that their use imposes on society. This encourages them to take account of the value of the spectrum to other users and uses and to make decisions that will generate maximum benefits for society.

3.84 We acknowledge that there will be some goods or services that the market, left to itself, would fail to provide in sufficient quantity. Options for ensuring the provision of these goods include public provision funded from taxation, and regulation to mandate operators to provide particular benefits.

3.85 If such a market failure arises in the provision of a particular good or service and it is considered that subsidy should be provided to secure its provision, it is generally more efficient for those goods or services to be explicitly subsidised by government from general taxation, and for those providing them to have the same incentives to use spectrum efficiently as other spectrum users, than to seek to support provision through subsidising the price of an input such as spectrum.

3.86 This is for two broad reasons:

- Subsidising one input such as spectrum creates the risk that investment choices will be distorted, such that the subsidised users will tend, over time, to retain more spectrum than they need, increasing the opportunity cost resulting from excluding other uses and user; and

- An input subsidy on its own does not guarantee that the input will be used, nor that the desired outputs will be supplied using it. Direct subsidies and/or regulations can be targeted at the desired outputs and so are normally more likely to be effective, and proportionate.

[56] In economics terms, these wider benefits correspond to positive externalities, such as safety or security, or mitigation of negative externalities, such as pollution or greenhouse gas emissions.

3.87 Following this principle, socially beneficial but uncommercial services do not generally receive goods, services or resources at subsidised rates but, as a general rule, pay the market price. Normally, we would not expect to treat spectrum differently in this respect from any other inputs. However, we recognise that there might be cases where it is appropriate for us to take a different approach. We would assess the desirability of promoting the wider value to society of particular uses of spectrum, and the means available (besides spectrum fees policy) for promoting that value, for each licence sector specific rate review, in order to reach a decision appropriate to the circumstances of each case. In particular, we propose to continue to treat certain 'safety-of-life' charities as exceptions (see paragraph 3.91 below).

3.88 While we do not think that subsidising spectrum, by means of reducing AIP fees, is normally a focused or effective way of promoting wider policy objectives, we do recognise the importance of these objectives in considering the impact of fees. As set out above in relation to our proposed principle 3, we will carefully consider any potential impact on safety or other wider social policies in our decisions on whether and how to apply AIP in individual sectors.

3.89 We provisionally conclude therefore that in setting AIP fees, we will continue to have regard (among other things) to the desirability of promoting economic and other benefits that may arise from the use of spectrum, including wider policy objectives [57], making a case-by-case assessment.

3.90 In general, we consider that direct subsidies and/or regulatory tools other than AIP are normally more likely to be efficient and effective. However, there might be cases where we consider it appropriate to take a different approach. For example, we have explicitly built in plans to consider the potential impact on outputs from setting AIP fees, when we come to draw up proposals for AIP fees to apply to spectrum used for terrestrial digital broadcasting:

> "If it seems likely that there could be material detriment to citizens or consumers from the effects of AIP on broadcasting output, there are a number of ways available to Ofcom, government and spectrum users to address this. For example, changes to regulation could be made, or additional public support made available, to ensure that the required output was safeguarded if this was thought necessary. Finally, as we made clear in the consultation document, these means could include potentially not introducing AIP, or levying it at a reduced rate, if this was necessary to ensure public service broadcasting requirements could be met."[58]

We propose to continue the concession for safety-of-life charities

3.91 However, fee concessions may be justified in particular cases. For example, charities that have as their main or sole objective the safety of human life in an emergency currently benefit from a concessionary AIP rate in recognition of the fact that they are predominantly or totally funded by the public on a voluntary basis and that their

[57] In line with s.3(2)(b) of the WT Act 2006.
[58] http://www.ofcom.org.uk/consult/condocs/futurepricing/statement/

operations depend critically on radiocommunications[59]. We propose to continue this approach.

3.92 In Section 4, we consider whether concessions on cost-based fees might be appropriate to promote wider policy objectives and propose that in certain circumstances it might be appropriate.

Proposed principle 6: AIP and wider policy objectives
Socially beneficial uses of spectrum do not, as a general rule, justify AIP fee concessions, because direct subsidies and/or regulatory tools other than AIP are normally more likely to be efficient and effective. For cost-based fees there might be some circumstances in which it could be appropriate to provide a concession.

Issue 7: should we use AIP to promote innovation?

3.93 One of the matters we are required to have regard to in particular in setting AIP is the promotion of innovation.[60] One way in which we do this is through licence products known as “non-operational licences", available for test & development and academic research. Fees for these licences are charged at a level to encourage innovation, and are pro-rated when charged for licences lasting less than a year. These licences are aimed at providing access to spectrum for the development of new technologies including via technical trials. These licences provide access to spectrum on a non-interference and non-protected basis and are available for a maximum term of 12 months.

3.94 Stakeholders have however suggested that providing concessions on AIP may be another way of promoting innovation.

We do not think that AIP concessions are normally the most effective way to promote innovation

3.95 The primary aim of AIP is to promote greater efficiency in the way that spectrum is used, as AIP can be expected to provide incentives for spectrum to be released for more productive uses where spectrum is scarce. Relieving spectrum scarcity will promote innovation in electronic communications by making it easier and faster for new and existing providers to access spectrum and develop new services. In other words, by achieving its main objective – more efficient use of spectrum – AIP can be expected to increase opportunities for innovative uses.

3.96 In general, we do not consider that it would be appropriate to give concessions on AIP fees to users wishing to provide innovative commercial services via access to scarce spectrum on the same terms, including security of tenure, as other operators paying the full fee rates. The reason for this presumption is that AIP only applies to spectrum that is scarce. If we give some users concessions on AIP fees they may use more spectrum than they would have if faced with the full value of the spectrum. As a consequence, this may exclude users who would have been willing to pay the full fee, and who might therefore be expected to have generated more value from the spectrum. We therefore think that it could run counter to our objective to secure optimal use of spectrum to offer scarce spectrum to some users for a reduced fee

[59] Regulation 5 of the Wireless Telegraphy (Licence Charges) Regulations 2005
[60] Sections 3(2)(c) and 3(2)(d) of the Wireless Telegraphy Act 2006

and that it could provide incentives that could distort investment decisions by new operators.

3.97 While we do not think, in general, that concessions on AIP fee rates are likely to be an effective or appropriate way of promoting innovation, we do need to consider the desirability of promoting innovation when proposing fee rates. In considering the impact of fees we will therefore consider, when making specific AIP fee proposals, whether there is any undue impact on the ability of innovative services to access the spectrum.

3.98 In Section 4, we consider whether concessions on cost-based fees might be appropriate to promote innovation and propose that in certain circumstances it might be appropriate.

Proposed principle 7: AIP and the promotion of innovation
It will generally not be appropriate to provide AIP concessions in order to promote innovation. We may consider whether cost-based fees should be set at a lower level in order to promote innovation.

Issue 8: should we make greater use of auction outcomes or trading prices to inform AIP fees?

3.99 In informal submissions to the SRSP, some stakeholders asked us to abandon our opportunity cost methodology in favour of prices that are more closely aligned with observed indicators of market value. Others represented to us that recent auction outcomes suggest a lower value of spectrum than implied by current AIP levels[61].

3.100 In principle, Ofcom could base AIP reference rates directly on observed market prices of spectrum, when these are available. Alternatively, those prices could be used as a cross-check on our estimates. There are three principal potential sources of direct market-based information on spectrum value:

- *Information from auctions* – prices in a well designed auction will provide an estimate of the market valuation of the spectrum over the life of the licence concerned;
- *prices in spectrum trades* – in a trading market with many buyers and sellers acting independently, prices would reflect the market valuation of the spectrum;
- *share prices* – share prices of firms that hold spectrum might reflect the market's valuation of the firm's assets, including its spectrum access rights.

3.101 In principle, we agree that direct observations of market prices are highly relevant as indicators of spectrum market values. The growing number of auctions and spectrum trades makes it timely to consider taking greater account of such market observations where they are available. For the reasons discussed below, however, this will need to be done with care, neither in a mechanistic manner nor to the

[61] *First Intellect Submission to Ofcom's Spectrum Pricing Review: Principles and Formula for Fixed Links* (2009). http://www.intellectuk.org/component/option,com_docman/task,cat_view/gid,258/dir,DESC/order,date/limit,10/limitstart,10/

exclusion of other considerations. Subject to that caveat, we propose to make greater use of observed market valuations in setting AIP in future.

3.102 In our view, the usefulness of auction and trading prices will generally depend on the extent to which:

- we can find, or reliably determine, like-for like comparisons – that is, whether traded spectrum is comparable to the spectrum for which reference rates are sought, and whether trades are recent enough to be relevant;
- AIP can be linked to observed market prices without distorting bidding or trading incentives.

Information from auctions

3.103 Auction valuations are in practice affected significantly by the specific circumstances of the award, including:

- how much spectrum is available, and how it is packaged;
- whether it is adjacent to an incumbent's holding or harmonised;
- the timing of the award relative to other spectrum market developments (e.g. availability of complementary spectrum elsewhere in Europe);
- the degree of harmonisation and equipment availability at that frequency;
- the nature of the technical limitations imposed in the licence, for example to protect incumbents in the same or neighbouring bands;
- any non-technical conditions, for example on network roll-out.

3.104 This can make it difficult to establish valid like-for-like comparisons from the relatively small number of auctions to date. Auction outcomes will also reflect wider service market conditions and expectations at the time, which may no longer apply.

3.105 In addition, linking AIP directly to auction prices may distort bidding incentives. For example, if bidders expect the AIP fees they pay on some of their spectrum to be revised in light of the auction price of spectrum they are bidding for, they may have an incentive to bid less aggressively. In addition, if the direct link between AIP and auction prices affects some bidders' valuations but not others' (for instance, if only some bidders are subject to AIP on their other spectrum holdings), auction results might be distorted.

Trading prices

3.106 Trading prices are not required to be revealed to us. The parties to a trade are invited on the trading application form to tell us how much has been paid but do not do so in practice. We have recently consulted[62] as part of a wider consultation on Providing Spectrum Information on whether to require trading price disclosure and publish the

[62] http://www.ofcom.org.uk/consult/condocs/providing_spectrum_information/

information. Views were mixed on this issue and we are currently considering the responses.

3.107 Even if trading prices were disclosed to us, many spectrum trades occur as part of a business sale in which spectrum is not separately valued. Further, where spectrum trades occur between companies in the same group the agreed price may not represent a true market valuation. For these reasons, only trades between separate entities in which spectrum has been separately valued are likely to be informative[63].

3.108 Lack of homogeneity of the value of spectrum and a relatively thin trading market would, as in the case of auction prices discussed above, make it problematic to generalise from one trade to the value of other spectrum. The prices in a handful of bilateral trades will be sensitive to the particular circumstances of the trades concerned and may be unreliable indicators of market value.

3.109 Finally, linking AIP directly to trading prices may distort the trading market, since traders may have an incentive to keep trading prices low or may be deterred from trading altogether if they expect AIP to increase with traded prices.

Share prices

3.110 With share prices paid in company acquisitions, the value of spectrum licences will not normally be separately valued. Separating out their value from that of the firm's other assets can be a very complex exercise. In addition, spectrum licences will be one class of many assets, some of which will be intangible, such as the market's view of the quality of the management or goodwill and brand. Where those other factors are important, within the overall valuation of the company, there is scope for very large errors in valuing spectrum on the basis of a share price. For these reasons, it seems unlikely that share prices would provide a reliable or useful basis for informing AIP levels.

Proposed principle 8: use of market valuations
We will take account of observed market valuations from auctions and trading alongside other evidence where available. However, such market valuations will be interpreted with care and not applied mechanically to set AIP fees.

Issue 9: how should we account for uncertainty in market values when setting fees?

3.111 In setting AIP fees, we are seeking to provide a long-term signal of the market value of spectrum so as to inform and incentivise spectrum users' investment choices.

3.112 We seek to assess the market value of spectrum on the basis of market evidence (where available) and estimates based on the LCA methodology, see Section 4 for further details. In setting AIP fees we need to consider, and take account of, the risk that our estimates of market value are either too high or too low relative to the actual market value.

[63] Trading prices will also reflect the expected fee payable on the licence. Hence the price would need to be adjusted upwards to reflect the market valuation of that spectrum without that fee to avoid circularity.

3.113 Our policy to date has been to err on the side of caution when setting AIP fees. In practice, this means that we have generally set AIP fees below our estimates of spectrum value. This is because we have taken the view that over-estimating the market price is likely to pose a greater risk than under-estimating it. In reviewing this approach we have taken into account input from independent consultants as well as our own growing experience in spectrum pricing.

The costs to society depend on whether we set fees too high or too low

3.114 When setting fees for some licence sectors, we may have recent and direct market information about the value of the spectrum. For example, if there has been a recent auction of similar substitutable spectrum then, subject to the considerations set out in Issue 8, this may provide a reliable indication of market value. Where this is the case we can estimate the market value with a higher degree of confidence and there is a lower risk that AIP fees based on this evidence will be either too high or too low.

3.115 However, in many cases we do not have reliable market evidence of spectrum value. As discussed in Section 4 we may then seek to estimate the market value of spectrum through an LCA study of the opportunity cost in the current use, and (where relevant, under proposed principle 3) feasible alternative uses. In setting fees we then need to assess the extent to which we can rely on our estimates of opportunity cost as indicators of market value, taking into account the confidence we have in these estimates, and the impact on consumers and citizens of setting AIP fees above or below the true market price.

3.116 If we set fees that are materially **higher** than the long-term value of the spectrum then:

- Users who value the spectrum at the market rate (that is, users who could make productive use of the spectrum at a fee level that reflected the true long-term market value) may vacate the spectrum, reducing the availability of services to citizens and/or consumers;
- However, this may allow greater access by higher value users and uses compared to the situation where fees are below the market price;
- Where licences are tradable, trading activity may be dampened, and may not happen at all because some of the additional value (beyond the market value) that a new user could generate from the spectrum has been captured in the fee. This could inhibit the development of secondary markets.

3.117 If we set fees that are materially **lower** than the long-term value of the spectrum then:

- There may be new or continued difficulty in making assignments to meet demand from existing uses;
- If there is a feasible alternative use that is of higher value than the current use, then that use may be delayed or may not gain access to the spectrum;
- These adverse effects may be mitigated to some extent if licences are tradable. This is because trading will facilitate the movement of spectrum from lower value users and uses to higher value users and uses if secondary markets are efficient.

3.118 In general, setting AIP fees above or below the true market value will result in losses for citizens and consumers. In addition, both also have implications for current users.

The potential costs to society are affected by the difference in the values of current use and alternative use

3.119 When setting AIP fees we need to assess the risk that setting AIP fees higher may result in a loss of value from existing spectrum users that outweighs the additional value that may result if the spectrum moves to higher value users or uses in future.

3.120 We note that this will depend, to some extent, on the difference in value between the existing and feasible alternative use (where relevant). That is, if the value of feasible alternative use is much higher than the value of current use, then the potential loss from setting fees too low (delaying or keeping out the higher value use) is more likely to be higher than the potential loss from setting fees too high.

3.121 We note that a refinement to our current conservative approach which recognises the potential relevance of the value of spectrum in feasible alternative use has been proposed by independent consultants[64]. In such cases, they suggest, setting AIP fees near the lower, current value (as is our approach in general) may provide few if any efficiency incentives, and that it may be appropriate to be less conservative in setting AIP fees to encourage spectrum to migrate towards higher value users or uses in a timely manner[65]. In practice, this would mean placing greater weight on the estimated value of spectrum in feasible alternative uses than has hitherto been the case.

3.122 This could lead to benefits for society if the new users who are willing to pay the increased fee level can collectively generate higher benefits, in total, than the benefits that are lost from current users vacating the spectrum.

3.123 We note that AIP fees are only one tool that we use to manage spectrum and that in some cases it is appropriate for us to use other tools such as intervention to achieve our overall aim of optimal use of spectrum. For example, where there is a clear case for re-allocating spectrum quickly from a low value use to a higher value use, because the benefits of such a change and our confidence in the outcome is high, we would normally look to intervene and clear the band in an planned manner rather than looking to price to effect such a change.

However, there is no certainty that feasible uses will appear

3.124 When we propose to take account of new feasible alternative uses, not yet deployed in the band – either because there is no equipment currently available, or because this alternative use would be incompatible with the current use –the demand from that use is generally less certain than demand from existing users. That is, even if the alternative use is feasible within the relevant timeframe, we may not have a high degree of certainty that this use will eventually appear in this particular band even if spectrum is made available. In part this is because there may be a number of

[64] Aeronautical and Maritime Spectrum Pricing (2007), page 6 and 59-65. http://www.ofcom.org.uk/research/radiocomms/reports/spectrumaip/aipreport.pdf

[65] For instance, if an alternative use places a much higher value on spectrum in a band than the existing use, a less conservative price which transfers spectrum to the high value use (but leaves some spectrum unused) may be preferable to one that is too low and denies spectrum to higher value uses.

potentially substitutable bands that the alternative use could use that are not currently available to it, and which could become available quicker, or for which equipment may become available earlier. Alternatively demand for such feasible alternative use may have been over-estimated, or may subsequently be met by a competing service provided over different spectrum, or by a non-spectrum means.

3.125 As a result, when considering the possibility of feasible alternative use there is a risk that by setting fees too high current users would exit but demand from the alternative use may not appear. Accordingly, in cases where the current benefits are proven but the demand (and benefits) from the alternative use are less certain, it may be appropriate to continue to give proportionately more weight to the loss of current benefits than to delays in potential future benefits from alternative uses being realised.

Efficient secondary markets limit the risk of setting fees too low

3.126 As noted above, if spectrum is tradable this may mitigate the adverse effects of setting AIP fees too low, since higher value users can seek to purchase spectrum from lower value users in the secondary market. In addition, setting fees too high may have the additional disadvantage of discouraging the development of spectrum markets.

3.127 When setting fees we therefore propose to take account of the extent to which trading is expected to promote optimal use, and where this is the case, to apply a more conservative approach when setting fee levels for spectrum that is tradable. We note that whilst the majority of licence sectors are now tradable, our view is that secondary markets in general remain immature at present, see Annex 6 for further details.

Our proposed approach in future

3.128 Taking all of the above issues into account, when deciding where to set an AIP fee level, we propose to assess the relative risks of setting AIP too high or too low, on a case-by-case basis. We consider the following factors to be key to such an assessment:

- the difference between the current and alternative use values;
- our confidence in the values of existing and alternative uses. whether the demand from alternative uses is proven, for example because they are already using the band, or whether the use is feasible but demand for the specific band uncertain;
- whether licences are tradable and the extent to which trading is expected to promote optimal use.

3.129 In view of the inherent trade-off between setting AIP fees too high and too low, we propose that in future we should not apply an overriding presumption that fees should always be set conservatively, and instead should consider the specifics of each case to determine the appropriate fee level given the available evidence on the factors indicated above.

3.130 When we consult on specific fee proposals, we will explain all the factors that we have taken into account in framing our proposals and, following consultation, the reasons for our decisions.

Proposed principle 9: setting AIP fees to take account of uncertainty
Where there is uncertainty in our valuations and the likelihood of demand for feasible uses appearing we will consider the risks from setting fees too high, or too low, in light of the specific circumstances. When spectrum is tradable we will consider the extent to which trading is expected to promote optimal use, and will also have particular regard to the risk of undermining the development of secondary markets.

Summary

3.131 This section has discussed a number of core principles underlying our overall approach to setting AIP. We would welcome views on these and on whether there are others we could usefully clarify.

Question 1: Do you agree with our proposed core principles of setting AIP? Are there additional matters that it would be helpful to clarify?

Section 4

Our methodology for setting levels of spectrum fees

4.1 The previous Section discusses a framework of policy principles for spectrum pricing. This Section concerns our general methodology within that framework for determining the level of fees. It discusses both AIP and cost-based fees. It also addresses some of the issues we take account of when assessing the impact that our proposals may have on spectrum users and others.

4.2 To recap, in principle, we:

- apply AIP where demand for spectrum in a given band or geographical location[66] cannot be satisfied on the basis of cost-based fees, in order to provide incentives to use spectrum in a way that maximises the benefits for society; and
- set fees to reflect the relevant costs of managing the radio spectrum where demand for spectrum can be accommodated in the spectrum that is available.

How we will set AIP-based fees

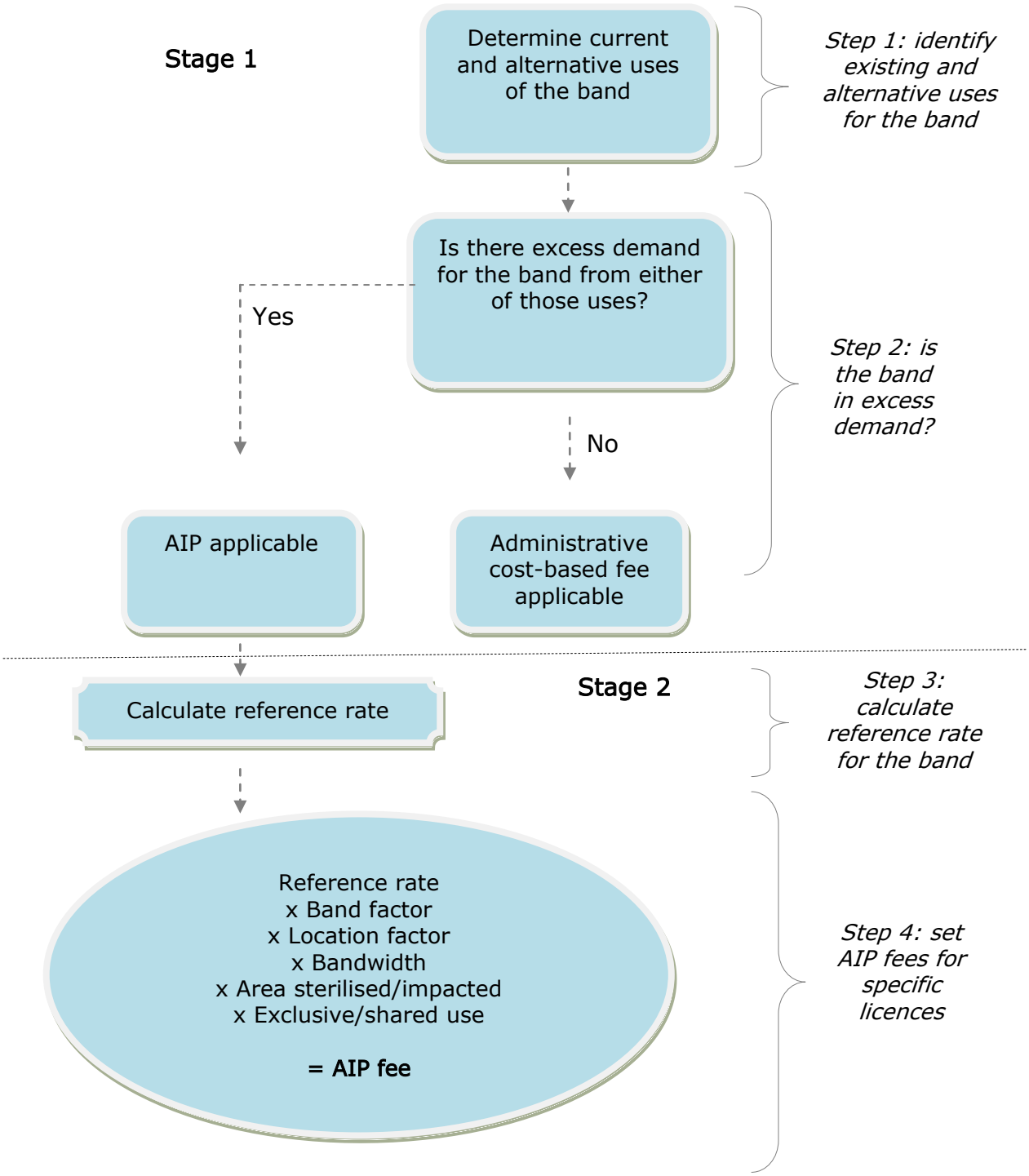
4.3 AIP fees need to be set at a level that reflects the value of the spectrum. This value might not vary smoothly with frequency but will likely show marked discontinuities.

4.4 Our general methodology for setting AIP in specific bands in which AIP is appropriate involves two stages, each with two steps, as described below and illustrated in Figure 7

- Stage one - determining whether to apply an AIP-based fee or a cost-based fee
  - Step 1: identify the existing and potential alternative uses of the band within the relevant timeframe
  - Step 2: determine whether there is excess demand for that spectrum from the existing or alternative uses
- Stage two - setting AIP fees for licences giving access to those bands
  - Step 3: calculating the reference rate to reflect the opportunity cost of the bands
  - Step 4: setting AIP fees for individual licences based on the specific nature of licensed use

[66] Appendix A explains why we do not currently differentiate between geographical locations in certain licence classes (for instance, fixed links).

Figure 7: Steps in setting AIP spectrum fees



Step 1: identifying possible use

4.5 As discussed in Section 3, in determining the feasible alternative uses, we will take account of the existing use and feasible alternative uses over the relevant timeframe taking account of relevant constraints on the use of the band.

Step 2: assessing where there is 'excess demand'

4.6 As discussed in the Section 3, we propose to use congestion as an indicator of excess demand from the current use looking ahead over the relevant timeframe.

4.7 Congestion is a matter of degree. Where use is exclusive, it is measured by the number of assignments in relation to the existing capacity of the band/location in question, where it is shared channel loading will provide a better measure. Appendix A provides further detail on how we have measured frequency and geographical congestion for different licence classes and why we do not do so in some instances (e.g. in fixed links).

4.8 The degree of congestion can be expected to vary by frequency, geographical location and time. As explained in Section 2, spectrum is far from homogeneous and some bands will be more valuable, and hence more in demand, than others in the same area; or a band may be in high demand at or between certain geographical locations but not others. In general, when evidence indicates that congestion varies significantly between frequency bands or locations, we will seek to assess this effect band-by-band and location-by-location if it is practical and proportionate to do so.

4.9 There may also be temporal variations, for example where temporary assignments are made in bands and locations, demand may have peaks throughout the year or time of day. One clear example of this is demand for spectrum used for PMSE, in which some demand is relatively constant throughout the year (e.g. in theatres or stadia), but demand at other locations may have notable peaks (e.g. specific sporting or cultural events). Although this temporal variation may apply in a number of other licence classes, in general it will not apply to all licences but only a small proportion of users, and so we do not currently propose to apply a temporal factor as a matter of course to all AIP fees.

4.10 Frequency bands and geographical areas in which congestion is low or very low normally attract a fee reflecting our costs rather than the value of the spectrum, while those that are heavily congested are charged an AIP fee based on our estimate of the value of that spectrum. Moderately congested bands and areas may attract an intermediate AIP-based fee to anticipate and forestall future congestion even though congestion there is not yet heavy. This was the approach adopted by the RA in 1997 and the one we continue to apply[67].

4.11 How we assess excess demand in practice depends on whether we are considering the existing or an alternative use. Appendix A provides further details.

- For *existing use*, we have used a variety of methodologies to assess congestion that depend on the type of licence. These methodologies may need to be refined, depending on the available evidence available at future fee reviews.

[67] Radiocommunications Agency. *Implement Spectrum Pricing* (May 1997), pages 14, 21-31, 41-44 and 48 http://www.ofcom.org.uk/static/archive/ra/rahome.htm under Publications/Spectrum Pricing. This approach has been proposed in other jurisdictions. See ACMA. *Opportunity Cost Pricing of Spectrum. Public Consultation on Administrative Pricing for Spectrum Based on Opportunity Cost* (April 2009), pages 27 and 28. http://www.acma.gov.au/webwr/_assets/main/lib310867/ifc12-09_final_opportunity_cost_pricing_of_spectrum.pdf

- For *alternative use*, we identify the alternative uses as in step 1 above and determine whether there is excess demand for the band in question from the alternative uses, taking account of whether there are other bands that are suitable and available for the alternative use which could be used to meet demand. To do this we look at congestion in bands available to it as a proxy for excess demand in the band in question. If there is, this suggests that it would be appropriate to apply AIP to the band in question.

Proposed methodology 1: AIP and congestion
In setting AIP fees, we will assess current and future congestion in existing use and demand for feasible alternative uses in the frequency band in question and at different geographic locations over the relevant timeframe, given technological, regulatory and international constraints and using readily available evidence.

Step 3: calculating the 'reference rate'

4.12 The 'reference rate' denotes the value of a standard quantum of spectrum, which is then combined with a band factor to take account of variations in value between bands in step 4 to set fees for individual assignments plus additional modifiers to take account of the specific technical details of the licensed use in question. For example, the current reference rate for cellular and business radio is £1.65 per MHz per km^2 and the rate for point-to-point fixed links between 1.35 GHz and 57 GHz is £88 per 2x1 MHz for each bi-directional link. The background to the adoption of these rates in the past is explained in Appendix A.

4.13 In setting the reference rate, we will consider any available evidence from market transactions and apply the general principles discussed in the previous section.

Difference in value between existing and alternative uses

4.14 If, in Step 2 we find that a band is congested given the demand from current use and higher value feasible alternative uses, we calculate:

- 'value in existing use' or 'existing use opportunity cost' – the value that an average user in the current use of the band (or bands) attaches to a small additional block of spectrum in the band, which measures the marginal value of that spectrum in its existing use;

- 'value in alternative use', or 'alternative use opportunity cost' – the value of that spectrum for an alternative use of the band (or bands). As previously discussed, we consider only those alternative uses that are higher value, feasible within the relevant timeframe given any relevant constraints that apply to use in the band.

4.15 Where an alternative higher value use exists, this suggests that society will be better off if some or all of the spectrum moves to the higher value use over time. Setting AIP fees based on the value in the existing use and, where appropriate in an alternative use, gives incentives for spectrum to move towards the most valuable uses as well as towards users that can generate greater benefits for society.

4.16 If there are no alternative higher value uses for the spectrum, setting AIP fees equal to the value in the existing use can be expected to encourage spectrum to move from lower to higher value users in the current use.

4.17 We will estimate the reference rate according to the following steps:

a) we calculate the value in the existing and alternative uses identified in step 1;

b) if there is a higher value feasible alternative use, we set the reference rate at a point between the two values, dependent on the perceived relative risks of setting the fee too high, or too low (see Issue 9 in Section 3 for further detail);

c) if there is no feasible higher value alternative use, we set the rate at the value in existing use.

How we value spectrum

4.18 To estimate the opportunity cost of spectrum we currently primarily use the 'least cost alternative' (LCA) method. This involves estimating the value to an average user of a small additional block of spectrum in the band, in terms of avoided cost. This is generally based on a study of the cost of long-term alternative network designs or technology choices that would be made in response to a small reduction in spectrum held by a user. Importantly the LCA method looks at the choices that would be made in long-term, rather than short-term. In the short-term users' responses would usually be more limited and more costly.

4.19 Consultants have also suggested that we adopt a second method for estimate the opportunity cost of spectrum, namely the discount profit (DP) method.

4.20 The DP method, unlike the LCA method, also looks at the revenues that would be lost if a user were to lose a small amount of spectrum, and therefore requires an understanding of the revenues as well as costs of the business of an "average user of spectrum".

4.21 Table 1 below provides a summary of the advantages and disadvantages of each method. Further details on both of these methodologies are provided in Appendix A.

Table 1: advantages and disadvantages of the LCA and DP methods

	Advantages	Disadvantages
LCA method	• Information requirements are not demanding • Easy to implement	• Not applicable if output cannot be assumed constant/ if revenue implications cannot be ignored • Sensitive to assumptions, will produce a range of values • Requires judgement to choose from range of values estimated
DP method	• Method used by users to estimate values in an auction • Is applicable if output cannot be assumed constant/ if revenue implications cannot be ignored	• Same as LCA (except first point) • Requires more cost information and uncertain revenue forecasts than LCA

4.22 Overall, we consider that the LCA method is generally fit for purpose and propose to continue using it but acknowledge that the DP method offers a useful alternative in certain circumstances. We will explain which method has been used, and the reasons why, in making any future fee proposals.

Proposed methodology 2: reference rates
Reference rates will be based on the estimated value of the spectrum in the current use and any feasible alternative uses. These estimates will be informed, where appropriate, by the available market information (if any), and economic studies of spectrum value.

Step 4: setting fees for individual licences

4.23 The reference rate expresses the value of spectrum for a standard unit of spectrum in typical use. This can be expressed in units of MHz per square kilometre or per link. In order to convert reference rates into fees for individual licences, it is necessary to capture variations in the value of the spectrum, driven by the feasibility of alternative uses to the current use and other factors explained in Section 2. It is also necessary to convert them into the actual assignment bandwidth and area from which others are excluded.

4.24 We discuss these factors in following paragraphs.

4.25 In designing fee-setting algorithms or fee structures, we also generally endeavour to avoid making them excessively complex as this may obscure the price signals they send and make it more difficult for users to make informed decisions.

How we allow for the differences in value between bands used by a licence class

4.26 To capture variations in the value of spectrum by frequency and geography, we use two ‘factors’ or ‘modifiers’:

- *Frequency band factor*, which is intended to reflect differences in the value of bands subject to the same reference rate, as proxied by the degree of frequency congestion in those bands;
- *Location factor*, which captures the value of the spectrum where the licensee operates, as proxied by the degree of geographical congestion.

4.27 For many licence classes we continue to use an approach based on two reference rates that we inherited from the RA. One a ‘mobile’ and the other a ‘fixed’ rate, which are then adjusted via a band factor. These rates were set in relation to the value of spectrum in its existing uses only.

4.28 There are several problems with our continued use of a simple two reference rate approach in the pricing of some licence classes. This method may:

- create an artificial ‘cliff edge’ in pricing at the boundary between ‘fixed’ and ‘mobile’ spectrum;
- fail to acknowledge the potential for alternative uses of those bands;

- be in tension with our move towards technology and service neutrality; and
- not capture variations in market value with sufficient granularity.

4.29 However, since 2005 we accepted a method recommended by Indepen in which rates are set in relation to both the value of spectrum in its existing and in other potential uses for the band. However, to date we have not implemented this refined approach to fee setting to some of the major licence classes, including fixed link and satellite fees. Applying this method where we do not currently do so would go some way to address the artificial "cliff edge" and would be consistent with technology and service neutrality. This issue is explained in more detail in Annex 7.

4.30 In future reviews, we propose to extend the Indepen recommendation to those licence classes where it has yet to be implemented and to consider introducing additional reference rates, where appropriate and proportionate, to take into account other drivers that influence the variations in value between bands, whilst being mindful of the desirability of having fee algorithms that are no more complicated than necessary. We will explain our approach and our reasons for proposing it, in any future fee reviews.

How we measure the 'amount of spectrum'

4.31 In prior discussions with stakeholders, we received submissions suggesting that certain variables included in one of our fee algorithms are redundant[68]. In individual fee rate reviews, we propose to analyse the extent to which the variables in our current pricing algorithms and fee tables are consistent with the principles set out in this document, as confirmed or amended in light of responses to this document.

4.32 As shown in Figure 7 above and following the approach initially recommended by Smith NERA and adopted by the RA, we measure the amount of spectrum denied by considering the following features of the assignment:

- the *bandwidth* denied to others measured in kHz, MHz or other units of frequency;
- the *area* denied to others measured in km^2;
- the *degree of exclusivity*, a measure of the extent to which the individual assignment of spectrum is shared by others or is exclusive.

4.33 Appendix A sets out in more detail the general AIP algorithm, the rationale for each of these variables and how they have been adapted in specific licence sectors, either by including more variables such as the path length factor in the fixed links algorithm or by omitting others.

Proposed methodology 3: calculating individual licence fees
In converting reference rates to fees, we will take account of the value of the amount of spectrum denied to others. This will generally be based on frequency,

[68] *First Intellect Submission to Ofcom's Spectrum Pricing Review: Principles and Formula for Fixed Links* (2009). Available at: http://www.intellectuk.org/component/option,com_docman/task,cat_view/gid,258/dir,DESC/order,date/limit,10/limitstart,10/

geographical location, bandwidth, geographical coverage or other measure that reflects the geographical extent of co-ordination requirements, and in some cases the exclusivity of an assignment.

How we set cost-based fees

4.34 Where we do not charge on the basis of AIP we aim to set fees at a level that reflects a contribution to the relevant costs of managing the radio spectrum. We refer to such fees as 'cost-based'.

4.35 We currently charge cost-based fees where:

- spectrum is not scarce or
- where AIP-based fees would be less than the relevant spectrum management costs.

4.36 However, under some circumstances, we may depart from this principle. In particular, we might do so where we consider that requiring licensees to pay a fee that reflected our costs would not secure optimal use of spectrum.

Which costs are relevant for setting cost-based fees?

4.37 Our powers, provided under the WT Act 2006, permit us to recover all of the cost we incur in connection with our spectrum management functions. However, we do not have a duty to so. We have discretion in setting cost-based fees, having regard (in particular) to the need to ensure optimal use of spectrum and we may, depending on the circumstances, consider it appropriate to reflect only part of our spectrum management costs in these fees.

4.38 We have not undertaken a detailed review of the basis of our cost-based fees since Ofcom took over the role of spectrum management from our predecessor, the RA. As a result most of the cost-based fees we charge were set originally by the RA.

4.39 Since Ofcom was formed, where we have set new cost-based fees we have done so in order to recover some of our costs of managing specific classes of licences. We have also, on occasion, set fees lower than this level, for specific purposes, for example to avoid pricing out demand for "non-operational" licences that support test and development activities, which can help to promote innovative uses of spectrum. We have also set fees to be zero for some licences, including Amateur and Ships' licences (a decision which we have made clear will not be re-opened by this consultation).

We could reflect our 'avoidable' costs in cost-based fees

4.40 When we review cost-based fees in future we will need to consider what costs we would seek to reflect in cost-based fees for specific licence sectors. One concept that is widely used to differentiate the different types of costs that could be attributed to a product, such as a licence product, is that of 'avoidable' cost. For the specific case of the spectrum management of licence classes, or groups of licence classes, avoidable costs would be those costs that we would not need to incur in the long term if a particular licence class, or group of licence classes, were to cease to exist.

4.41 There is inevitably an element of judgment involved in categorising costs as 'avoidable' or 'unavoidable'. Avoidable costs exclude both spectrum management overheads and corporate overheads. Depending on the nature of the specific spectrum use, the following is a non-exhaustive list of the types of cost that might be considered avoidable:

- planning and co-ordinating individual assignments;
- issuing licences;
- maintaining information about all relevant assignments;
- providing advice and information to licensees after the licence is issued;
- undertaking specific enforcement action related to that licence class.

4.42 As we discuss in Section 5, we believe that there is significant benefit to spectrum users in having a degree of stability in fee rates. Attributable spectrum costs may fluctuate year by year if, for example, there is a one-off or infrequent regulatory project relating to a single licence class or group of licence classes. These projects by their nature are unlikely to be repeated for a number of years, if ever. We therefore believe that we should average our costs over a 3-5 year period in order to smooth the peaks and troughs in activities undertaken related to any specific set of licences over the period.

4.43 As explained in Section 5, we are proposing in this consultation to only review fees in future where evidence indicates that their likely misalignment is sufficiently material.

4.44 We would be interested to hear stakeholders' views on whether they would welcome us adopting the approach described above based on 'avoidable costs' as and when we review cost-based fees for specific licence classes.

We could reflect avoidable costs and some overhead costs in our cost-based fees

4.45 Taken altogether, the licences we issue drive, to a greater or lesser degree, some of our overhead costs. To take an extreme example, if there were no licences and all uses were licence exempt, our spectrum and corporate overheads attributable to spectrum management would be materially reduced, because our continuing activities would be reduced[69]. It may therefore be appropriate for us to consider attributing some overhead costs to some licences, provided this would not impact on our objective to secure the optimal use of the spectrum.

There may be cases in which it would be justified to charge less than our avoidable costs

4.46 There may be cases in which it would be justified to charge less than our avoidable costs because specific groups of users would not be able to access spectrum at a cost-based price.

[69] We would continue, for example, to represent the UK in international negotiations on spectrum allocations, and to propose and set spectrum management policies where needed to ensure continued optimal use, such as amending the exemption regulations.

4.47 In considering whether to set fees at a lower level, we would take into account:

- whether the cost of collection of the fees would form a material proportion of the overall fee;
- whether the benefits of the use to society overall were greater than our costs and no other funding was available for users to support their spectrum use;
- whether the benefits of the use in promoting innovation could be justified; and
- whether any particular group of citizens or consumers would be unfairly and adversely affected by fee levels that reflected our costs.

Question 2: Do you agree that we should charge cost-based fees where AIP is not appropriate or AIP would not cover our costs? How do you think we should set cost-based fees in future fee reviews? Are there particular factors you think we should take into account, for specific licences fees or cost-based fees in general?

Assessing the impacts of our proposals

4.48 Once we have developed detailed proposals for changes to fee rates, we are required to undertake a formal Impact Assessment that considers the impacts on affected parties and the consequent impact, if any, on citizens and consumers.

4.49 If such an assessment indicates that the proposed policy is likely to have detrimental effects, or not achieve its objective, we would then to revisit these proposals to address such issues. Two such examples are briefly described below.

Assessing the impact of our proposals on licensees

4.50 If we consider increasing fee levels as a result of a fee review, we will, especially if these increases are significant in terms of the existing fees and the context of the businesses of the affected users, consider whether to phase in the increases in fees. This may be desirable in order to avoid disrupting pre-existing business plans or, in the case of public sector users if necessary to coordinate substantial increases to overall budgeting requirements within the public expenditure planning cycle.

4.51 The longer term benefits to society of setting fees on AIP principles can in general be expected to more than offset the overall financial effects on users from any fee increases. We will, in any event, provide an analysis of costs and benefits in the Impact Assessments we produce for specific fee proposals. Nevertheless, changing licence fees, especially where there are sizable increases, carries risks, especially in the short-term. For example, there could be inefficient disruption if existing arrangements are reviewed and changed by users over a short period. This may cause temporary or even permanent losses for society. We recognise the need to manage these risks to avoid adverse impacts.

4.52 In implementing changes to fees, we will balance these considerations and manage the risks on a case-by-case basis. Generally speaking, phasing fee increases will reduce the risk of disrupting pre-existing business plans, public service plans and investment decisions and will also allow us to monitor the effects and modify our proposals if necessary in the light of experience. It will also allow businesses time to adjust their plans and avoid incurring additional costs. On the other hand, it will tend

to delay the effects of the fee change in promoting optimal use and the resulting gains to citizens and consumers and increase the risk that the changes will be overtaken by market and other developments by the time they are fully implemented.

4.53 To date, we have applied different phasing periods, depending on the specific circumstances. Periods of 3-5 years have been most often applied but there is no presumption that in any future reviews, one phasing period is more likely to be right than another. On the other hand, where we propose lower fees, we would normally plan to implement the reductions as soon as practicable. Delay would tend to increase the risk that unnecessarily high fees cause spectrum to be under-utilised with resulting loss of benefits for society.

4.54 We believe this approach is consistent with our duty to further the interests of citizens and consumers and our concept of AIP as a tool to promote optimal use of spectrum over time.

Assessing the impact on competition of our proposals

4.55 In general, the effect of AIP should be positive for competition in the service markets concerned, because it will relieve spectrum scarcity and make it easier and faster for new market entrants offering potentially new services to enter the market, promoting competition in electronic communications. This will benefit consumers of such services by widening choice and reducing prices.

4.56 We have also considered whether it would potentially be appropriate to use AIP to promote competition more generally, or to address existing competition problems in downstream markets. For example, should AIP be reduced selectively for certain licences in order to encourage entry into a downstream market, or to offset the competitive advantages of a dominant firm?

4.57 Depending on the circumstances of the case, pursuing such an objective could in principle be consistent with our duties to promote competition where appropriate. However, such a means to promote competition via changes in competitors' relative input costs may not be the most effective approach. UK competition authorities, including Ofcom, already have powers to identify and address competition problems directly under the Communications Act 2003 and general competition law. Further, it would, in practice, need to be done in a manner that was consistent with our duty to ensure that fees are non-discriminatory[70] and also with EU law on state aid.

4.58 There might also be particular cases where we are considering changes to fees in which it is necessary to take account of downstream competition effects, including the possibility of the existence of windfall gains.

4.59 If our analysis of the specific circumstances of any particular case indicates that it is appropriate to take downstream competition effects into account when setting AIP fees, we will make this explicit in our proposals and provide supporting evidence and reasoning when we consult on them.

Proposed methodology 4: impact assessments
We will undertake Impact Assessments on our fee proposals to identify any potential detrimental impacts to spectrum users, consumers and citizens. We will need to

[70] Article 13, Authorisation Directive 2002/20/EC.

consider carefully the balance of benefits and risks of the implementation of all changes in fees.

Summary

4.60 This section has discussed a number of methodology principles for setting AIP and cost-based licence fees. We would welcome views on these.

Question 3: Do you agree with our proposed fee-setting methodology principles? Are there additional matters that it would be helpful to clarify?

4.61 Annex 8 provides some qualitative illustrations of how two major licence classes might be affected by our overall proposals. They should not be taken as a definitive view of how fees will change in future in those or other sectors, nor as implying the priority that we attach to reviewing fees in those sectors.

Section 5

Plans and priorities for spectrum fee reviews, and evaluation

5.1 Sections 3 and 4 discuss the general framework of principles and practice by which we propose to set AIP and cost-based spectrum fees.

5.2 We are not yet in a position to present detailed proposals for particular licence fees. Before we could do this, we would need to conduct an in-depth review for the licence sector that takes into account the detailed circumstances and characteristics of the sector and then to consult further. This section proposes a new process for deciding whether to carry out future sector or licence-specific fee reviews and consults on potential near-term priorities.

The process of reviewing fees to date

5.3 Given the pace of technological and market change, it would be surprising if the circumstances and factors that we take into account in setting fees did not vary over time. There is therefore a case to review fee levels periodically in order to ensure that they remain reasonably aligned with market values and are therefore effective in securing optimal use of spectrum.

5.4 In our 2004 *Spectrum Pricing* statement, we said that we would review fees periodically with the intention of more closely tracking spectrum value. That statement, in combination with the 2002 Review of Radio Spectrum Management and 2005 *Independent Audit of Spectrum Holdings* by Professor Cave and the Government's response to both of those, set out a forward programme of policy work to review fees policy and fee levels for various uses. Our consultations on extending AIP to spectrum used for broadcasting (concluded in 2007) and more recently our consultations on new fees to apply in the aeronautical and maritime sectors complete that cycle of fee policy reviews.

5.5 We now need to decide how to continue the review process in future.

Our objectives in making proposals for planning future reviews

5.6 We have identified two key objectives that we believe we should take into account in deciding whether and when to conduct future fee reviews in order to promote the optimal use of spectrum:

- **Stability for stakeholders**. Stakeholders benefit from fee stability because it reduces regulatory uncertainty and risk in relation to investment decisions and decisions to sell or buy spectrum licences. Society benefits in turn because spectrum users can take efficient decisions at the right time, rather than delaying decisions in expectation of fee changes;

- **Degree of alignment of fees**. Fees should reflect the market value of spectrum, or our management costs, and these costs change over time. If fees become materially out of line with the opportunity cost they seek to reflect this will create

risks that spectrum will not be used efficiently. Specifically, if fees are too high compared with the spectrum value, then some spectrum may be left idle. Conversely, if fees are too low spectrum may remain in less efficient hands.

5.7 These two objectives – stability/regulatory certainty and accuracy of fee levels – are potentially in tension with one another and we therefore need to strike a balance between them.

Regulatory options for planning future reviews

5.8 We have identified a range of options for how to determine when to undertake a fee review, in order to assess how likely they are to serve these two objectives:

- Option 1: automatic review on a fixed time cycle (for example every 3, 4 or 5 years);
- Option 2: maximum indicative term before next review (for example "normally we would expect to review no later than 5 years from the last review"). Fees could be reviewed earlier;
- Option 3: minimum indicative term before next review (for example "normally we would not expect to review these fees for at least 5 years");
- Option 4: propose reviews only in response to evidence that it would be justified after an initial assessment of costs and benefits. This would include setting out the factors that might trigger a review. We might seek views from stakeholders on whether such a fee review should be a priority for the next year in the Annual Plan. We may still, however, on occasion undertake a fee review where there is a clear need without including this in the Annual Plan[71];
- Option 5: Option 4, subject to a minimum indicative term before next review: propose reviews only in response to evidence that it would be justified after an initial assessment of costs and benefits. This would include setting out the factors that might trigger a review. We might seek views from stakeholders on whether such a fee review should be a priority for the next year in the Annual Plan. We may still, however, on occasion undertake a fee review where there is a clear need without including this in the Annual Plan[71]. In addition, at the conclusion of any review we would set a minimum indicative term before we would normally expect to review these fees again.

5.9 The various options for scheduling reviews have different implications for our two objectives. Our assessment of these implications is given in Table 2 below.

Table 2: an assessment of scheduling options against our two objectives

Option	Stability and/or predictability for users	Aligning fees with market conditions	Other costs and benefits
1. Automatic review on a fixed cycle	Fees will be regularly and routinely reviewed even if there is no evidence that the value has changed	Fees will be up to date with lags limited to a certain number of years	Reviews triggered by the fixed term might not have been priorities on the evidence of demand and

[71] There will also still remain the need to set fees for any new licence products developed.

Option	Stability and/or predictability for users	Aligning fees with market conditions	Other costs and benefits
	introducing uncertainty to the market and consuming stakeholder and Ofcom resource.	(e.g. 3, 4 or 5 years).	use.
2. Maximum term before next review	Uncertainty during maximum term as to whether or not fees will be changed.	Fees can be reviewed before the end of the period if circumstances suggest they should change. Lags will be limited to the maximum term	Reviews triggered by the maximum term might not have been priorities on the evidence of demand and use.
3. Minimum term before next review:	Fees could be assumed to be stable for the minimum term. If we did not provide additional clarity beyond that period, changes to fees would be uncertain	Changes in value or our costs would not be reflected during the minimum term.	If the minimum term is relatively long, will reduce Ofcom and stakeholders' resources focused on fees
4. Set priorities following possible consultation in the Annual Plan. Propose a review only when evidence it is justified	Fees could be assumed to be stable unless or until Ofcom consults on the justification for a review. When reviews are triggered by major changes stakeholders will usually have had notice of these changes for some time and will be consulted on the materiality of these changes.	Flexibility to reflect relevant changes in market values or our costs, where these are materially different from current fees. Small misalignments might not be reflected for a considerable time.	Ofcom and stakeholder effort limited to reviews that are material and a priority.
5. Set priorities following possible consultation in Annual Plan. Propose a review only when evidence justifies it and at conclusion of a review, set a minimum term before any further review.	Fees could be assumed to be stable unless or until Ofcom consults on the justification for a review. When reviews are triggered by major changes stakeholders will usually have had notice of these changes for some time and will be consulted on the materiality of these changes. Following a review, fees could be assumed to be stable for the minimum term.	Flexibility to reflect relevant changes in market values or our costs, where these are materially different from current fees. Small misalignments might not be reflected for a considerable time. Changes in value or our costs would not be reflected during the minimum term.	Ofcom and stakeholder effort limited to reviews that are material and a priority.

Ofcom's preferred option for planning future reviews

5.10 In light of this assessment, we believe that the right balance would be struck if we pursue Option 5 from now on.

5.11 This is because Option 5:

- Creates a high degree of stability and regulatory certainty, without losing the ability to review when circumstances change:
  - Avoids resource cost and diversion of management time running and responding to a review when it is likely fees are not materially out of line with either spectrum value or our costs, and thereby reduces the risk of disruption for no or little benefit but allows for reviews, subject to consultation, when there is evidence that they would be justified;
  - Allows, where appropriate, for a period of certainty following a review, after which we would revert to the expectation that a further review would only be proposed if justified.
  - Ensures, through the Annual Planning process, that stakeholders have the opportunity to present their own evidence and discuss the need for any specific fee reviews and that these are prioritised with reference to alternative spectrum management activities and not in isolation, where the need for a fee review is not clear cut.

Our proposal

5.12 Therefore, considering our preference for Option 5, we are proposing that, in future:

- If we think there is a case for a fee review we will seek views from stakeholders when we consult on Ofcom's Annual Plan. We may still, however, on occasion undertake a fee review where there is a clear and urgent need without including this in the Annual Plan;
- we will propose to conduct a fee review only where the evidence suggests that a review would be justified, including evidence of a likely and sufficiently material misalignment between the current rates and the spectrum value, or between the current rates and our spectrum management costs; and
- when we carry out a review in future, we would also specify, where appropriate, a time period during which we would not normally expect to carry out a further review.

How we will judge if there is a sufficiently material misalignment between fees and spectrum value or spectrum management costs

5.13 In considering the options for scheduling future reviews, we are proposing that we will, in future, give explicit weight to the advantages of stability in promoting efficient investment decisions and in reducing potential inhibition of efficient trades. This means that where the available evidence is that fees may only be out of line with spectrum value by a small amount, the added benefits that greater accuracy might bring may not be sufficient to warrant the level of stakeholder and Ofcom resources it would require to conduct a review.

5.14 We therefore need to consider how we might judge whether any potential misalignment between current fees and value, or between current fees and management costs, is sufficiently material to warrant a fee review.

5.15 In the case of cost-based fees, if our cost base were to change materially from the basis on which we set fees this would indicate a need to review fee levels.In the case of AIP-based fees we have to consider what sources of evidence could be available to suggest that the spectrum value is materially different from the current fee level.

5.16 There are a number of sources of evidence that we would expect to consider, in considering whether AIP-based fees were materially out of line with the spectrum value. In particular, changes in:

- *Congestion levels.* The existence or expectation of potential congestion arising at existing fee levels over the relevant timeframe or, conversely, the expectation that congestion will fall away. In some cases, we will have good visibility of significant changes in congestion levels from the data collected through our licensing operations. An example of this could be an increase in the number of licence applications that we cannot meet, which would point to an increase in congestion. Conversely, an absence of users in a band might indicate that demand was lower than we had expected when we set fees;

- *Information from spectrum auctions and trades.* As discussed in Section 3, these may be highly relevant in assessing the demand for, and hence the value of, comparable spectrum;

- *Increased supply of substitutable spectrum.* This could arise in several ways: directly by a major spectrum release, by Ofcom or another major spectrum holder such as MOD or a large private sector user, or indirectly as a result of technological developments. Technological advances in a particular use may make it possible to extend the ability to provide applications to new frequency bands, increasing the effective supply of spectrum and so reducing congestion in that use, or alternatively to provide an existing or enhanced service using less spectrum;

- *Expectation of a regulatory change that will affect the usability of spectrum*. A new agreement on equipment standards, or a new harmonisation measure for a particular use may make a particular use of spectrum more viable because of the expectation that equipment will become available and affordable. Regulatory changes may affect the value of the spectrum directly affected, and potentially the value of substitutable spectrum.

5.17 We would also expect that stakeholders would continue to be proactive in identifying evidence of some or all of this type if they feel their fees are out of line with the spectrum value.

We will consider whether this evidence points to a fee review or a different response to secure optimal use over time

5.18 If there is evidence that the difference between the spectrum value, or our management costs, and our current fee level is sufficiently material then this will typically point to a fee review. However, on a case-by-case basis we may consider if a different regulatory response would be more effective in securing optimal use.

5.19 For example, if the increase in the value of the spectrum is due to the feasibility of an alternative that cannot co-exist with the current use, and if this alternative is very much higher than the value in current use then the benefits of a change of use may

be such that it would be justified for us to propose to clear the band by direct intervention.

5.20 On the other hand, if demand for the spectrum has reduced considerably at the current fee level, while the first response might be to consider reducing the fees, the reduction in demand might also have resulted from a change in circumstances of users in a band heavily constrained by international regulation. E.g. the previous use for which it was ring-fenced may have moved to a new privately provided infrastructure and band without considering removing the constraints on the use of the spectrum. In such circumstances we would look to remove any unnecessary constraints on the use of the spectrum.

Expectations of future change should be taken into account in the timing of reviews

5.21 Stakeholders have suggested to us that, if major developments are in prospect, it may be a more efficient use of our and stakeholders' resources to wait until the outcome is known before reviewing fees. We agree that would appear sensible if such changes are likely to materially change the conclusions we may come to, and if these changes are anticipated to occur shortly.

5.22 For example, if a project to clear a band is imminent, then it would be inefficient to seek to set fees for those users, as we will have concluded that the best way to secure optimal use is to give notice of termination to existing users. If that clearance is expected to be followed by an award of spectrum that will have a significant impact on the levels of congestion in substitutable bands, it may be sensible to wait until after the clearance and award, which will produce potentially relevant information about the value in substitutable bands, before reviewing fees in these substitutable bands.

5.23 If we have confident expectations of a release of spectrum, or a regulatory change such as harmonisation, within the short term, we propose therefore that we would normally wait until the matter had been resolved before reviewing fees.

5.24 In practice, as regulatory and other potential changes that could affect future spectrum value are continually being contemplated, a judgement will need to be made in each case of the risk that the conclusions of a fee review might be overtaken by regulatory developments, and the potential loss of benefits that delaying fee changes might result in.

5.25 Our proposed decision process for fee reviews therefore is illustrated in Figure 8 below and may be summarised as follows:

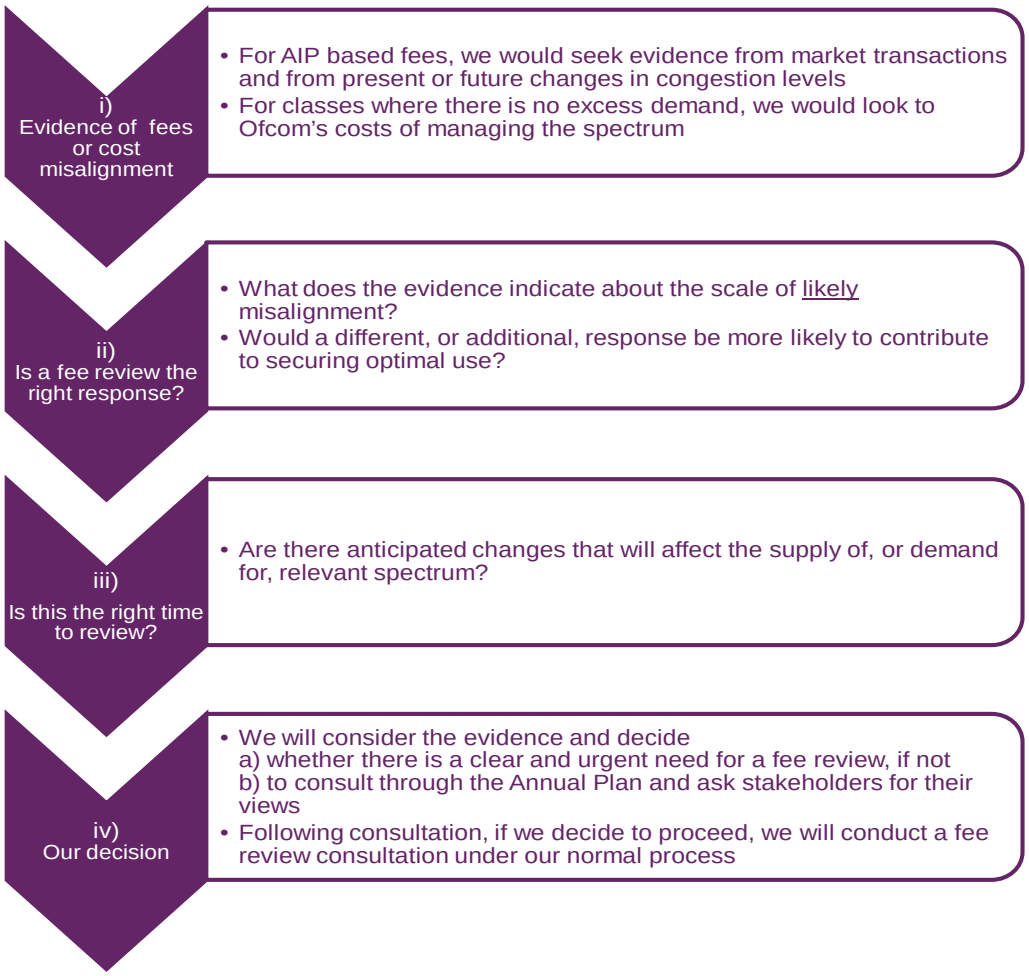
i) *Is there evidence to indicate that fees are out of line with opportunity cost or administrative costs?* In order to decide whether or not a particular licence fee needs to be reviewed at a particular time, we will first look for evidence of a sufficiently material misalignment of the fee and the relevant opportunity or spectrum management cost. This is because severe misalignment may indicate that fees at the present level are unlikely to be achieving our objectives of promoting optimal use of spectrum or reflecting our spectrum management cost.

ii) *Is there evidence that a fee change would increase the efficiency of use more effectively than other spectrum management responses?* As noted before,

spectrum pricing is only one of a range of regulatory approaches available to us. There may be other steps we could take such as identifying more spectrum that could be made available for the current use, initiating a planned programme to clear the band for an alternative use, or reviewing the regulations around the spectrum such as international or domestic technical constraints.

iii) *Is this the right time to review?* We will also be responsive to evidence of an urgent need to change a fee, for example that the existing fee level is causing serious detriment, such as a majority of users unexpectedly vacating a band without realistic prospect of new users taking up the available spectrum - or that a very valuable band is, or is likely to become, severely congested without a change in fee level.

Figure 8: proposed future process for carrying out fee reviews



Question 4: Do you agree with our proposal to move away from regular full-scale reviews to reviewing in response to evidence, as set out in Option 5?

Question 5: Do you agree with our process for assessing the priority of future fee reviews? Are there other sources of evidence of misalignment between fees and

spectrum value or spectrum management costs that you can think of, and what weight should we give them?

Our proposals for future sector-specific fee reviews

5.26 Conducting fee reviews and responding to consultations has resource implications for Ofcom and stakeholders and we aim to strike a reasonable balance between reflecting significant changes in market conditions promptly and providing fee stability and regulatory certainty. We are therefore minded to move away from a pre-announced programme of regular fee reviews and instead to focus on sectors in which there is clear evidence that a review would be beneficial.

5.27 In order for stakeholders to assess the potential effects of the criteria set out above for consultation, we have looked at the information currently available to illustrate what they might suggest in terms of which licence sectors might be candidates for review.

5.28 As an illustration, if we adopted the criteria above, some representations made to us in the past about the current fees for point-to-point fixed links at the higher frequencies may indicate evidence that these fees would be a candidate for review. Some stakeholders have also expressed concerns about the absence of a geographical factor in the fixed link fees algorithm, which might also suggest fees are not aligned with geographical variations in value.

5.29 Some stakeholders have also observed that market evidence of the value of the spectrum revealed in recent auctions does not align with current fees. Subject to a consideration of comparability, this might suggest that the fees in some bands are not aligned with value.

5.30 Other licensees may consider that there are good reasons to review fees for different licence sectors. Having published these proposed criteria for fee reviews, and our proposed evidence for misalignment of fees with spectrum value or our management costs, we are inviting all stakeholders to consider not only whether our criteria are right, but whether they have evidence that any particular type of fee should be reviewed.

Question 6: *Based on our proposed criteria, or other criteria you would propose we use, what do you think our priorities for future fee reviews should be? Please tell us your reasons for thinking these should be prioritised. Do you agree that we should prioritise a fixed link fee review, as some stakeholders have suggested to us?*

Post-review evaluation

5.31 When we make regulatory decisions we should, as a matter of good practice, evaluate their effects to assess whether they had the effect intended.

5.32 In practice, we will only be able to evaluate the effectiveness of AIP fees qualitatively and may not be able to draw definitive conclusions. There are three main reasons why it may not be possible to assess the effectiveness of AIP fees:

- we cannot accurately predict users' reaction to fee changes. As we noted in Section 2, we do not attempt to predict these in setting fees, because fees are not set to secure specific responses from users but to inform their decisions over

time without prejudice to what those decisions are. As a result, we would not have a direct and quantified measure of 'success' in terms of individual users' behaviour;

- changes in behaviour might not be solely attributable to fees and it can be difficult to isolate the effects of spectrum pricing; and

- responses to fee changes may take several years, or longer, to become apparent (see Section 2, Issue 4: 'the relevant timeframe').

5.33 Since these aspects of fees policy make direct measurement of achievement of objectives difficult, we propose to approach monitoring in two ways:

- First we will collect and assess evidence that users (individually or collectively) are changing their spectrum requirements, for example by reducing their assignments or returning some altogether in highly congested bands. As discussed above it will not be possible to identify definitively the reasons for these changes but it may suggest that spectrum pricing has had some role in users' changing their use.

- Second, we propose to identify some broad measures which would indicate that fees were **not** contributing to optimal spectrum use:

  - If congestion and demand in a band or location (from the existing and feasible alternative use) worsens, then our fees may not have been effective in ensuring the most efficient users have access to the spectrum. In considering whether this evidence indicates that a further fee review might be appropriate we would consider other regulatory responses (such as, where possible, making more spectrum available);

  - If, conversely, spectrum is not used, or used only to a small extent, for a considerable time, then our fees may be excluding efficient users. Similarly to the case above, we would consider, alongside a fee review, whether any relevant constraints on the use of the spectrum could be reduced or removed.

Question 7: Do *you agree with our proposed approach to post-review evaluations?*

Annex 1

Responding to this consultation

How to respond

A1.1 Ofcom invites written views and comments on the issues raised in this document, to be made **by 5pm on 21th June 2010**.

A1.2 Ofcom strongly prefers to receive responses using the online web form at https://www.ofcom.org.uk/consult/condocs/srsp/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 SRSP.contact@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.

Alison Esslemont
Floor 3, SPG
Ofcom
Riverside House
2A Southwark Bridge Road
London SE1 9HA

Fax: 020 7981 3208

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

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

Further information

A1.7 If you want to discuss the issues and questions raised in this consultation, or need advice on the appropriate form of response, please contact Alison Esslemont on 020 7981 3117.

Confidentiality

A1.8 We believe it is important for everyone interested in an issue to see the views expressed by consultation respondents. We will therefore usually publish all

responses on our website, www.ofcom.org.uk, ideally on receipt. If you think your response should be kept confidential, 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 consultation period, Ofcom intends to publish a Statement in October 2010.

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

Ofcom's consultation processes

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

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

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

A1.16 Vicki Nash
Ofcom
Sutherland House
149 St. Vincent Street
Glasgow G2 5NW

Tel: 0141 229 7401
Fax: 0141 229 7433
Email vicki.nash@ofcom.org.uk

Annex 2

Ofcom's consultation principles

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

Before the consultation

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

During the consultation

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

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

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

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

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

After the consultation

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

Annex 3

Consultation response cover sheet

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

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

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

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

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

Cover sheet for response to an Ofcom consultation

BASIC DETAILS

Consultation title:

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

Consultation questions

General principles

Question 1: Do you agree with our proposed core principles of setting AIP? Are there additional matters that it would be helpful to clarify?

Proposed principle 1: role of AIP
AIP should continue to be used in combination with other spectrum management tools, in both the commercial and the public sectors, with the objective of securing optimal use of the radio spectrum in the long term. AIP's role in securing optimal use is in providing long-term signals of the value of spectrum which can be indicated by its opportunity cost.

Proposed principle 2: users can only respond in the long term
The purpose of AIP is to secure the optimal use of spectrum in the long term, so as to allow users to be able to respond to AIP as part of their normal investment cycle. Even where users have constraints imposed on their use of spectrum, in general, some if not all users have some ability to respond to AIP.

Proposed principle 3: when AIP should be applied
AIP should apply to spectrum that is expected to be in excess demand from existing and/or feasible alternative use, in future, if cost-based fees were applied. In determining *feasible* alternative uses, we will consider the relevant timeframe, any national or international regulatory constraints, the existence of equipment standards, and the availability and cost of equipment.

Proposed principle 4: the 'relevant timeframe' for AIP
In general, we seek to assess excess demand, congestion and feasible alternative use over a timeframe that reflects the length of existing users' investment cycles.

Proposed principle 5: AIP and spectrum trading
Many secondary markets are unlikely to be sufficiently effective to promote the optimal use of the spectrum without the additional signal from AIP. Therefore AIP will likely continue to be needed to play a role complementary to spectrum trading for most licence sectors.

Proposed principle 6: AIP and wider policy objectives
Socially beneficial uses of spectrum do not, as a general rule, justify AIP fee concessions, because direct subsidies and/or regulatory tools other than AIP are normally more likely to be efficient and effective. For cost-based fees there might be some circumstances in which it could be appropriate to provide a concession.

Proposed principle 7: AIP and the promotion of innovation
It will generally not be appropriate to provide AIP concessions in order to promote innovation. We may consider whether cost-based fees should be set at a lower level in order to promote innovation.

Proposed principle 8: use of market valuations
We will take account of observed market valuations from auctions and trading alongside other evidence where available. However, such market valuations will be interpreted with care and not applied mechanically to set AIP fees.

Proposed principle 9: setting AIP fees to take account of uncertainty
Where there is uncertainty in our valuations and the likelihood of demand for feasible uses appearing we will consider the risks from setting fees too high, or too low, in light of the specific circumstances. When spectrum is tradable we will consider the extent to which trading is expected to promote optimal use, and will also have particular regard to the risk of undermining the development of secondary markets.

Fee-setting methodology

Question 2: Do you agree that we should charge cost-based fees where AIP is not appropriate or AIP would not cover our costs? How do you think we should set cost-based fees in future fee reviews? Are there particular factors you think we should take into account, for specific licences fees or cost-based fees in general?

Question 3: Do you agree with our proposed fee-setting methodology principles (set out below)? Are there additional matters that it would be helpful to clarify?

Proposed methodology 1: AIP and congestion
In setting AIP fees, we will assess current and future congestion in existing use and demand for feasible alternative uses in the frequency band in question and at different geographic locations over the relevant timeframe, given technological, regulatory and international constraints and using readily available evidence.

Proposed methodology 2: reference rates
Reference rates will be based on the estimated value of the spectrum in the current use and any feasible alternative uses. These estimates will be informed, where appropriate, by the available market information (if any), and economic studies of spectrum value.

Proposed methodology 3: calculating individual licence fees
In converting reference rates to fees, we will take account of the value of the amount of spectrum denied to others. This will generally be based on frequency, geographical location, bandwidth, geographical coverage or other measure that reflects the geographical extent of co-ordination requirements, and in some cases the exclusivity of an assignment.

Proposed methodology 4: impact assessments
We will undertake Impact Assessments on our fee proposals to identify any potential detrimental impacts to spectrum users, consumers and citizens. We will need to consider carefully the balance of benefits and risks of the implementation of all changes in fees.

Plans and priorities for spectrum fee reviews

Question 4: Do you agree with our proposal to move away from regular full-scale reviews to reviewing in response to evidence, as set out in Option 5?

Question 5: Do you agree with our process for assessing the priority of future fee reviews? Are there other sources of evidence of misalignment between fees and spectrum value or spectrum management costs that you can think of, and what weight should we give them?

Question 6: Based on our proposed criteria, or other criteria you would propose we use, what do you think our priorities for future fee reviews should be? Please tell us your reasons for thinking these should be prioritised. Do you agree that we should prioritise a fixed link fee, as some stakeholders have suggested to us?

Question 7: Do *you agree with our proposed approach to post-review evaluations?*

Annex 5

Consultancy research into AIP principles and methodology

The Smith NERA approach

A5.1 The approach to valuing spectrum initially used by Ofcom and its predecessor the Radiocommunications Agency followed a model provided in 1996 by Smith Systems and NERA[72] ("Smith NERA"). The Smith NERA approach was to use estimates of the marginal value of spectrum as proxies for the opportunity cost to a representative spectrum user in those bands where AIP fees were to be charged.

A5.2 The opportunity cost represents the benefits forgone from assigning spectrum to one use instead of another. The rationale for adopting this as the basis of the licence fees is that spectrum will thereby be directed into the best (i.e. optimal) use. The Smith NERA approach takes the opportunity cost as the cost of the least cost alternative to using spectrum that would enable the same output to be produced. This could be achieved via an alternative technology, such as by moving to a less congested spectrum band or, in the case of fixed wireless links, using fibre cables.

A5.3 Setting AIP fees equal to the cost of the least cost alternative means of delivery of the same output provides incentives for more efficient spectrum use within each spectrum band where the demand for spectrum is greater than the supply. Only those current users for whom the spectrum is worth more than the least cost alternative will want spectrum at that price. The other current users would have an incentive to hand spectrum back to the regulator or trade it in the market, and switch to the least cost alternative. Spectrum could then be redistributed to those users who valued it the most. This approach is a proxy for true opportunity costs, which also considers completely different alternative uses for the spectrum.

A5.4 AIP was first used for Public Wireless Networks and for Private Business Radio and introduced in step changes from 1998 to 2002. In 1999 it was extended to Fixed Links and to other mobile uses and by 2003 most licence class fees had been set to take account of spectrum management objectives using AIP rather than administrative cost. Spectrum used by the aeronautical and maritime sectors, and that used for digital terrestrial TV and radio broadcasting, are now very much exceptions in not attracting AIP fees at present. Ofcom stated its intention to apply AIP to spectrum used for digital terrestrial TV and radio broadcasting from 2014, in its 2007 statement *Future pricing of digital terrestrial broadcasting*[73].

2002 Cave Review

A5.5 After the first phase of applying AIP, during which the fees set tended to be approximately 50% of the opportunity cost values derived by the Smith NERA approach, the Government commissioned an independent review of spectrum management. This review was undertaken by a team led by Professor Martin Cave

[72] 'Study into the Use of Spectrum Pricing', NERA and Smith System Engineering Limited, April 1996
[73] Published 10 June 2007 at http://www.ofcom.org.uk/consult/condocs/futurepricing/statement/statement.pdf.

who reported on 6 March 2002[74]. The report recommended that greater use should be made of auctions and pricing, and, in particular, recommended that:

- AIP should be applied at more realistic levels and more comprehensively across spectrum uses;
- where AIP had already been implemented and there was, nevertheless, continuing evidence of spectrum shortages, prices should be set at full opportunity cost levels.

A5.6 The Government published its response in October 2002, broadly agreeing with the findings of the report. On AIP, the Government concurred that the methodology for valuing spectrum and for setting fees should be reviewed, as recommended by Professor Cave.

Indepen report 2004

A5.7 To update Smith NERA's original spectrum valuation work, a study was commissioned in 2003 which was awarded by competitive tender to a consortium led by Indepen and included Aegis and Warwick Business School. The final report for this study was published on the Ofcom website in March 2004[75].

A5.8 The Indepen team was asked to consider which types of spectrum use should attract AIP, to review and make recommendations about the methodology to be used, to provide illustrations of how the methodology could be applied, and to comment more widely on the use of pricing.

A5.9 Indepen largely confirmed the validity of the original Smith NERA valuation approach. However, Indepen also widened the opportunity cost methodology, by recommending that the assessed value of spectrum should also reflect alternative uses in addition to the existing use in the spectrum band. Indepen's report recommended the application of AIP to an increasing range of spectrum uses, and provided a new set of illustrative values for setting AIP fees on this updated basis.

Cave Audit 2005

A5.10 In 2004, the government commissioned a review of major spectrum holdings from Professor Martin Cave. The review considered what action could be taken to release the maximum amount of spectrum to the market and increase opportunities for the development of innovative new services. Professor Cave made a number of recommendations about the public sector's approach to spectrum management, and appropriate incentives to promote efficient decisions, in a wide ranging report published in December 2005(the 'Cave Audit')[76]. Most relevant to this review was his recommendation that:

> "AIP (Administered Incentive Pricing) is, and is likely to remain, a fundamental element in recognising the value of public sector

[74] See http://www.ofcom.org.uk/static/archive/ra/spectrum-review/2002review/1_whole_job.pdf.
[75] 'An economic study to review spectrum pricing', Indepen, Aegis Systems and Warwick Business School, February 2004, www.ofcom.org.uk/research/industry_market_research/m_i_index/spectrum_research/independent
[76] http://www.spectrumaudit.org.uk/final.htm

> spectrum use and encouraging improved spectrum efficiency. AIP should be extended to a wider range of public sector spectrum bands and uses."

A5.11 The government, in its response to the report published on 22 March 2006[77], supported the principle that pricing for public sector spectrum should be set on a comparable basis to the private sector, and stated its commitment to paying AIP on its spectrum holdings.

[77] http://www.spectrumaudit.org.uk/pdf/governmentresponse.pdf

Annex 6

AIP and tradable licences

A6.1 Spectrum trading is the transfer of rights and obligations under a WT Act licence or a grant of Recognised Spectrum Access (RSA). It is now over five years since we introduced trading for certain licence classes in December 2004. In our Statement on Spectrum Trading (2004) we said that we would continue charging AIP fees on both tradable and non-tradable spectrum after its introduction. We were concerned that trading alone might not be fully effective at promoting efficiency in the early stages of development of the trading market[78].

A6.2 This Annex discusses our experience with spectrum trading to date. The fundamental question is whether secondary markets are now sufficiently effective to enable us to dispense with AIP on tradable licences. We set out the extent to which any conclusions can be drawn about the effectiveness of trading in individual spectrum markets and the relevant implications for the future role of AIP on tradable licences.

Experience of trading to date in the UK

Tradable licence classes as of today

A6.3 Spectrum trading was introduced following our Spectrum Trading consultation (November 2003) and Statement (August 2004). Initially, it was introduced in certain business radio, fixed links and fixed wireless access licence classes, including scanning telemetry.

A6.4 Trading has now been extended to most business radio licence classes, so that some 90,000 licences are tradable today. Licences granted under our spectrum awards programme ('Spectrum Access Licences') are also tradable. In addition, trading is being rolled out in the public sector in support of the government's Forward Look programme to reform public sector spectrum management[79]. Table 1 lists the licence classes that are currently tradable.

Table A6.1: currently tradable licence classes and RSA

Business Radio	Fixed Links	Fixed Wireless Access	Spectrum Access	RSA
Area Defined	Point to Point Links	3480-3600 and 3605-4009 MHz	412-414 MHz and 422-424 MHz	Converted Spectrum Access and RSA for Radio Astronomy (150.05-152 MHz, 1660.5-

[78] Section 7 http://www.ofcom.org.uk/consult/condocs/spec_trad
[79] http://www.ofcom.org.uk/consult/condocs/sfrps and http://www.ofcom.org.uk/consult/condocs/sfrps08

				1668 MHz, 1668-1670MHz, 42.5-43.5GHz)
Technically Assigned	70-80 GHz self-coordinated Links	28.0525-28.4445 GHz and 29.0606-29.4525 GHz	542-550 MHz (Cardiff)	Converted Spectrum Access and Crown RSA (406.1-430.0 MHz)
Light licences: Simple UK, Simple Site, Suppliers Light	Scanning Telemetry		758-766 MHz (Manchester)	
			1452-1492 MHz (L Band)	
			1781.7-1785.0 MHz/1876.7-1880.0 MHz (GSM/DECT guard bands)	
			10, 28, 32 and 40 GHz	

Extent of market activity

A6.5 As of July 2009, the number of trades recorded in our Transfer Notification Register (TNR) is provided in Table A6.2 below[80]. This Table also provides in brackets () the percentage turnover that these traded licences represent of the total number of licences in the licence class that year.

Table A6.2: number of licences traded up to July 2009

	Number of licences traded (percentage turnover)[81]		
Licence classes	2005-2007	2008	2009 (up to July)
Fixed Links	7 (1.9%)	311 (0.8%)	356 (0.8%)
Business Radio	6 (1.1%)	16 (3.4%)	268 (0.6%)
Fixed Wireless Access	16 (106.6%)	0 (0.0%)	5 (33.3%)
Spectrum Access	1 (8.3%)	2 (16.6%)	0 (0.0%)

[80] http://spectruminfo.ofcom.org.uk/spectrumInfo/

[81] Turnover is here the number of licences traded in a year as a proportion of the average number of tradable licences in that year (up to July in 2009).

A6.6 For fixed links and business radio licences, it is more meaningful to compare turnover figures than the number of licences traded over time because:

- in May 2008 we introduced a new licensing system for fixed links so that each individual link now has its own licence, whereas before a single licence would be issued for multiple links[82] – hence, trades of multiple links will show as a single trade before May 2008 and as many individual trades thereafter;

- in business radio we extended trading to a very large number of licences in December 2008, which explains the large increase in the number of licences traded in 2009.

A6.7 Many trades in Table 2 are licence transfers within a group of companies that may be carried out for business administration reasons, or may be part of a commercial transaction. More recently, we have witnessed an increasing number of transactions between unrelated parties. Many of these occur when entire businesses are sold with radio equipment and the associated spectrum licences as assets.

A6.8 There has been considerable debate in the UK and elsewhere about the reasons for the observed levels of trading[83]. The level of trading may be due to a number of reasons:

- spectrum may have been efficiently allocated before trading was introduced, so there are limited or no potential efficiency gains from trading at present;

- trading activity may be intrinsically limited due to the heterogeneous nature of spectrum[84];

- the market may not have achieved its full potential due to the existence of barriers to trading or other factors.

A6.9 Few conclusions can therefore be drawn about the effectiveness of trading on the basis of trading volumes alone. Equally, comparisons with trading volumes in other countries (or with markets like the residential property market) must be interpreted with care. The level of trading in each country will depend on factors specific to individual spectrum markets, such as the extent to which spectrum was efficiently assigned initially or the flexibility or rigidity of national spectrum allocations.

A6.10 In order to identify barriers that might be inhibiting trading, we describe below the main factors which in our view explain the observed levels of trade.

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[82] http://www.ofcom.org.uk/radiocomms/ifi/licensing/classes/fixed/newsystem/faq/

[83] 4th Annual European Spectrum Management Conference Workshop: *How successful has the implementation of secondary market spectrum trading been since its introduction in Europe?* (2009). Policy Tracker Nov 2008 (*Which country has the most spectrum Trades?)* and Dec 2008 (*Architect of UK spectrum liberalisation disappointed with the number of trades*) discuss trading volumes in different countries and the success of the trading regime in view of those.

[84] In our Spectrum Trading consultation (November 2003) we said that we expected trading volumes to be relatively small compared with markets benefiting from central exchanges, due to the highly differentiated and imperfectly substitutable nature of the spectrum. See paragraph 7.3.2. http://www.ofcom.org.uk/consult/condocs/spec_trad/spectrum_trading/market_mechanisms/role_intermediaries

Determinants of the level of trading to date

A6.11 In our view, trading volumes to date reflect the following factors, in addition to the relatively short time since trading was introduced to the licence classes in Table 1:

- fragmentation of the 'spectrum market';
- availability of similar spectrum from Ofcom;
- long lifetimes of the associated equipment;
- lack of market intermediaries;
- paucity of information regarding price and spectrum holdings;
- costs of the authorisation process; and
- non-substitutability of licences due to licence conditions.

A6.12 We explain each of these factors in turn. The discussion focuses on fixed links and business radio licences, which constitute the vast majority of tradable licences to date, but will make occasional references to fixed wireless access and spectrum access licences.

There is currently no single 'spectrum trading market'

A6.13 As we explained in Section 2, the physical properties of the spectrum, historical allocations, differences in equipment availability and other factors (such as the long lifetimes of the associated equipment) currently limit the substitutability of different bands in users' eyes. This means that there is currently no single, homogeneous spectrum market but rather a collection of separate markets across the various frequency bands, and we expect the current state of fragmentation to continue in the foreseeable timeframe.

A6.14 To illustrate this point, business radio and fixed links operate in different parts of the spectrum[85], and are widely separated by non tradable spectrum allocated to broadcasting and aeronautical uses. As a result, business radio and fixed link users do not consider each other's frequencies substitutable or compete for the same spectrum, creating separate markets for each group of bands. Moreover, differences in equipment availability (for instance, between Band I and UHF2 in business radio or between the wide range of frequencies used for fixed links) and the long life of the associated equipment may create different submarkets even for spectrum allocated to each of those uses, to the extent that users do not consider those bands to be sufficiently similar or 'substitutable' owing to those factors.

A6.15 This fragmented nature of spectrum markets can be expected to limit the scope for trading.

[85] Business Radio operates between 26MHz and 466MHz, with most activity in the UHF1 (425-449MHz) and UHF2 (453-466MHz) bands. Fixed links operate between 1.35GHz and 57 GHz, or in higher frequencies where they are self-coordinated. The small exception is scanning telemetry, a fixed service that operates at around 460MHz.

Availability of spectrum from Ofcom

A6.16 Where equivalent licences are available from Ofcom as a primary provider, trading activity in secondary markets will normally be depressed since the costs of obtaining a new licence from us will normally be lower than those of finding a trading partner, negotiating terms and concluding a trade. In contrast, in bands and areas (or sites) that are fully occupied, licensees will have less scope to obtain licences from us and will have to procure them in the trading market.

A6.17 For example, fixed links and business radio licences are assigned administratively on a first-come, first-served basis. These licences (with the minor exception of area defined business radio licences) do not have wide geographical coverage and requests for new assignments can be readily accommodated at present. Outside very busy bands and areas, we rarely reject new requests because no channel is available, although users may sometimes have to accept a channel in a band that is not their first choice.

Long lifetimes of the associated equipment

A6.18 Spectrum is used in combination with equipment that normally has a lifetime of many years. In general, that equipment (e.g. antennas, towers and repeater stations in fixed links) is designed to operate on a specific band and cannot easily and quickly be re-tuned to different frequencies. Once those investments are made, users may not consider changing their spectrum use by trading their licence within that timeframe. Although there are exceptions where radio equipment is 'frequency agile', for many users spectrum choices are made only infrequently when equipment is refreshed.

A6.19 As a result, trading decisions may be inevitably tied up with investment or divestment decisions and may only be considered periodically as equipment falls to be replaced, or when a user plans to enter (or withdraw from) a market. This will tend to limit the number of traders and transactions in each spectrum market at any one time.

Lack of market intermediaries

A6.20 An effective market facilitates transactions by lowering traders' transaction costs relative to a situation where traders are unconnected and bargaining is mostly bilateral. In such a market traders can find a trading partner, agree on the terms, settle the trade and monitor performance of the contract without incurring substantial costs or delays in the process.

A6.21 In our Statement on Spectrum Trading, we noted that a range of market institutions could potentially emerge to expedite transactions and facilitate the trading process, including[86]:

- Brokers who link buyers and sellers wishing to trade spectrum but do not actually own spectrum themselves during the trade, like estate agents in the residential property market;

[86] http://www.ofcom.org.uk/consult/condocs/spec_trad/statement/sts.pdf Page 42.

- Market-makers who hold inventories of licences, taking positions with a view to trading out to a long-term buyer, or another trader;

- Band managers, who buy access to spectrum and then sell it or lease it onto other users – they can be particularly beneficial where individual end users have short term and/or unpredictable requirements for spectrum (e.g. PMSE use), or when spectrum is sold in relatively large blocks, but individual users only require small blocks.

A6.22 Respondents pointed out that their emergence would be slow and limited, at least in the initial stages of trading, as has turned out to be the case. The volume of trades to date may itself be discouraging the emergence of these market institutions. For the most part, spectrum trading continues to be bilateral and traders must find each other via private contacts, advertising or other ad hoc means[87].

A6.23 As we noted in our SFR, there is little evidence from countries where trading has been implemented that band managers will emerge[88]. Our policy is to structure licence conditions to facilitate the emergence of band managers where these are commercially viable and our consultation Simplifying Spectrum Trading has particular relevance for future band managers[89]. It would not be prudent, however, to assume that band management will emerge as a mechanism for facilitating increased trading in all spectrum markets.

Availability of price information and information on spectrum holdings

A6.24 Another key characteristic of a functioning market, linked to the existence of market intermediaries, is the existence of traders that are well informed about spectrum prices and licence holdings potentially available for sale.

A6.25 In efficient markets, ready availability of price information gives traders an indication of the appropriate price to pay. This reduces the scope for bargaining and disagreement over terms, and tends to lower trading costs. At present, however, there is virtually no price information in spectrum markets outside the small number of auctions held to date. The price of trades agreed in the secondary market is confidential to the parties and is not made public.

A6.26 A successful market also depends on the existence of a comprehensive register of spectrum holdings enabling buyers to identify assignments that are potentially available. However, stakeholders have expressed concerns in the past about the publication of information relating to their spectrum assignments as they feel that this might have security implications or be commercially sensitive. Up to now we have provided basic information via the Wireless Telegraphy Register (WTR), relating to the owner of the rights, contact details, licence type, frequency allocation and transmitter location. However, this information is currently limited.

A6.27 To address these issues, in our current consultation on Providing Spectrum Information we are asking for views on whether and how to release additional information in our WTR relating to spectrum holdings. We have also recently

[87] We are aware of two intermediaries, Red-M and Transfinite, who purchased rights to the 28GHz band in our 2008 auction and have recently started commercialising fixed links (and satellite earth station) assignments in that spectrum.
[88] http://www.ofcom.org.uk/consult/condocs/sfr/ Page 34.
[89] http://www.ofcom.org.uk/consult/condocs/simplify/summary/

consulted on whether we should require licensees who have obtained their licences through trading to state what they paid for them, potentially enabling us to make that information publicly available in a suitable form[90]. Views were mixed on this issue and we are currently considering the responses.

Costs of the authorisation process

A6.28 Another barrier to trade concerns the existence of regulatory burdens. In our current consultation Simplifying Spectrum Trading, we have identified that the current notification and approval process for trades might be unduly onerous and might be deterring trading activity – in particular, the need for us to be notified of, and consent to, intended trades [91]. We are consulting on several proposals to simplify the trading process and to introduce a new form of spectrum leasing.

A6.29 Similar concerns have led some other national regulators to consider measures designed to address unnecessary costs in the authorisation processes and other potential barriers, such as uncertainty about licence tenure[92].

Characteristics of licence types

A6.30 Finally, the technical specification of a licence can affect its tradability. Broadly speaking, we issue three types of licence:

- **Explicit area licences** are assigned administratively (e.g. area defined business radio licences) or via auction (e.g. spectrum access licences). They provide coverage over large geographical areas that are explicitly defined in the licence (e.g. the whole of the UK, one or more Nations or a UK region). They typically provide exclusive access to spectrum and allow licensees substantial flexibility to deploy transmitters in that geographical area. Of the tradable licence classes, area defined business radio, fixed wireless access and spectrum access licences are of this type;

- **Implicit area licences** (like technically assigned business radio licences) are assigned administratively and are site-specific. They give users the right to transmit from a given location over a relatively small geographical area that is not explicitly defined – it is determined instead by the technical parameters of the licence (e.g. antenna height and power). Licensees operate in a highly coordinated environment where assignments are carefully planned to enable sharing between many different users, often operating in the same geographical location. To avoid interference between neighbouring users, we specify in some

[90] Providing Spectrum Information. Implementing the Environmental Information Regulations 2004 (2009), paragraph 5.48.
http://www.ofcom.org.uk/consult/condocs/providing_spectrum_information/main.pdf
[91] *Simplifying Spectrum Trading. Regulatory Reform of the Spectrum Trading Process and Introduction of Spectrum Leasing* (2009).
http://www.ofcom.org.uk/consult/condocs/simplify/simplify.pdf
[92] See Australian Communications and Media Authority (ACMA). *Spectrum Trading. Consultation on Trading and Third Party Authorisations of Spectrum and Apparatus Licences* (2008), page 15.
http://www.acma.gov.au/webwr/_assets/main/lib310771/spectrum_trading.pdf.
Federal Communications Commission*. Policy Statement. Principles for Promoting the Efficient Use of Spectrum by Encouraging the Development of Secondary Markets* (2000), page 6 and subsequent consultations. http://wireless.fcc.gov/licensing/index.htm?job=secondary_markets

detail the technical parameters of these licences, including transmitter location, antenna characteristics, antenna height, maximum power and channel bandwidth.

- **Point-to-point licences** (such as fixed links licences) are also assigned administratively on a link-by-link basis. They give users the right to transmit between two fixed points and are also site or route-specific. As with implicit area licences, users operate in a highly coordinated environment where assignments are carefully planned and the technical parameters of the licence are tightly specified. This enables us to assign multiple overlapping fixed links in the same frequency and geographical area because of their use of highly directional antennas, which limits the extent to which they radiate outside the path between the two points.

A6.31 In general, point-to-point and implicit area licences, which constitute the vast majority of tradable licences today, are less amenable to trading than explicit area licences. Their detailed technical specification and the fact that they are site-specific limit their market appeal and may require prospective buyers to consolidate rights held by different licensees to achieve the desired coverage. This may underlie, to some extent, the differences between turnover volumes in Table 2 for fixed links and business radio licences (the vast majority of which are technically assigned) on the one hand, and for fixed wireless access and spectrum access licences on the other.

A6.32 These characteristics of fixed link and technically assigned business radio licences (more generally, of licences in highly coordinated interference environments) have raised doubts about the scope for trading and liberalisation of those licences to secure optimal use under the current licensing regime, particularly in spectrum used by fixed links[93].

A6.33 Our review has analysed whether the nature of point to point and implicit area licences under our current licensing regime (where licences are assigned administratively by Ofcom on a 'first come first served' basis) means that trading and liberalisation alone may not deliver efficient spectrum use. Specifically, we have considered whether those market mechanisms can be relied upon to put scarce spectrum to higher value uses and users.

A6.34 As regards **changes in use**, fixed links and technically assigned business radio licences occupy specific sections of spectrum. In view of this highly fragmented, intricate pattern of assignments, a change in use may involve negotiating with a very large number of users to acquire the spectrum required for the new service

[93] For instance, in our Statement on Spectrum Trading (2004, paragraph 4.28) respondents considered it unlikely that another party would require a licence for exactly the same radio link as an existing link. Similarly, in his Independent Audit of Spectrum Holdings (2005), Professor Cave considered the extent to which the link-by-link nature of licensing in fixed links imposes constraints on trading and liberalisation. He concluded that, although there could conceivably be a problem, it was too early to tell whether or not the market alone may achieve optimal use of that spectrum under our current licensing regime for those licences. Professor Cave considered alternative regimes such as band managers, overlay auctions or clearance projects.
Independent Audit of Spectrum Holdings (2005), Chapter 10.
http://www.spectrumaudit.org.uk/pdf/20051118%20Final%20Formatted%20v9.pdf

and to ensure that other licensees do not suffer harmful interference[94]. Changing use may depend on a very large number of users being willing to sell and coordination problems may arise.

A6.35 Hence, licence type characteristics can lock in historical uses and prevent changes in use in two ways:

- the cost of finding out and negotiating with many users ('transaction costs') may prevent acquisition of continuous blocks of sufficient size to allow changes in use, inhibiting the introduction of new technologies and services; and
- individual licensees may 'hold out' and prevent those changes[95].

A6.36 However, coordination problems need not be decisive and each case must be considered individually to judge whether trading is likely to prove effective in facilitating changes in use[96].

A6.37 In relation to **changes in user**, due to the site-specific nature of these licences the rights specified in the licence may need to coincide exactly with those required by the new user to enable a trade. For instance, the buyer of a fixed link or a technically assigned business radio licence would be restricted to making exactly the same use of the licence as the current user – e.g. to transmit between the exact same two points or from the same transmitter location, over the same frequency and geographical area and using the same power as that specified in the licence. This may be the case when licences are traded as part of a company acquisition alongside equipment and other assets.

A6.38 In many cases, however, the rights required by the new user will differ from those specified in the licence. The prospective buyer may need to buy the rights of a number of licences held by different licensees (covering various frequencies and geographical areas) and then request a licence variation from Ofcom. Again, this may entail negotiating and agreeing with each individual licensee, potentially involving large transaction costs, coordination and 'holding out' problems, depending on the number of parties to the trade.

A6.39 Figure 1 provides a simple instance of the coordination problems that may arise when trying to consolidate technically assigned business radio licences.

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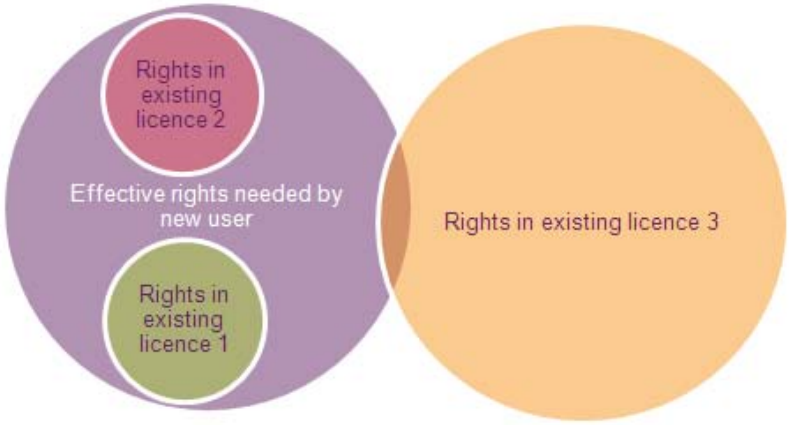
[94] Different technologies may interfere with established receivers which were designed to be robust against the original use, but might not be as robust to signals that are needed to support very different services.

[95] For instance, in one of our consultations Arqiva highlighted the problems created by a mix of powers and network densities in the same band. In its experience of industry co-ordination of Band III, Arqiva said, small operators in adjacent channels often have limited incentive to reach agreement and are incentivised to hold other spectrum users to ransom. Digital One's roll-out suffered considerable delays as a result which, in Arqiva's view, cannot be regarded as having been objectively beneficial. *Arqiva's Response to Ofcom's L-band Consultation,* paragraph 44. http://www.ofcom.org.uk/consult/condocs/1452-1492/responses/arqiva.pdf

[96] In the USA, Nextel used spectrum trading to acquire more than 40,000 Specialized Mobile Radio (SMR) licences delivering dispatch services and aggregated them for a national cellular network; and Verizon Wireless achieved its footprint through more than 50 secondary market transactions and auctions. See *Market Allocation of Radio Spectrum* by Thomas Hazlett and Coleman Bazelon at: http://www.itu.int/osg/spu/stn/spectrum/workshop_proceedings/Background_Papers_Final/Coleman%20Bazelon%20-%20Thomas%20Hazlett.pdf.

Figure A6.1: Consolidating rights from more than one licensee in technically assigned business radio



A6.40 Here, the prospective buyer needs the transmission rights held in licences 1 and 2 and a small proportion of those in licence 3. However, at present technically assigned business radio licences do not allow geographical partitioning. The buyer would need to purchase all the transmission rights held in licences 1, 2 and 3 and then request a licence variation from us to achieve the desired coverage. Each licensee may or may not be willing to sell all of its rights. Similar problems may arise when trying to consolidate rights by frequency rather than by geographical area (although partitioning by frequency to a minimum channel width of 6.25 kHz is allowed by the regulations).

A6.41 In summary, licence characteristics can lock in historical uses and users and act as an effective barrier to trade. This raises questions about the scope for trading and liberalisation under the current (first-come, first served) licensing regime to incentivise efficient use of spectrum in those licence classes where use is highly coordinated and assignments are intertwined by frequency or geography.

A6.42 These difficulties, however, are not insurmountable. Commercial organisations may take a coordinating role by acquiring spectrum through the market for themselves or with a view to trading it on. Alternatively, there are other measures that enable Ofcom or other public bodies to adopt a coordinating role to manage band re-planning or sharing[97]. Each case needs to be considered individually to judge whether market mechanisms or alternative approaches are likely to be in the best interests of citizens and consumers.

Conclusion - experience of trade to date in the UK

A6.43 In summary, the introduction of trading (alongside auctions and liberalisation) has allowed an increasing number of licensees to determine the allocation, assignment and use of their spectrum to a greater extent than was possible in the past. In general, these market mechanisms can be expected to increase the efficiency of

[97] "Band re-planning" involves revising assignments in a band to pack them in more efficiently. "Band sharing" involves fitting another service in the interstices between existing assignments.

spectrum use as licensees take advantage of the opportunity to sell their licences to other users who value them more highly.

A6.44 There is no single 'spectrum market'[98] for those licence classes that are currently tradable and this is likely to continue in the foreseeable future. This suggests the need for a separate analysis of each spectrum market in future fee rate reviews, and means that the role of AIP as a complement of other market mechanisms may well differ in each individual market.

A6.45 We have identified a number of reasons why trading volumes may be expected to be relatively small compared with other markets, including the long lifetimes of the associated equipment and the availability of similar spectrum from Ofcom.

A6.46 Other factors point to the existence of barriers to trading. These include lack of market intermediaries, paucity of information regarding price and spectrum holdings, the costs of the trading authorisation process and licence characteristics under the current licensing regime, in addition to the relatively short time since trading was introduced and the limited amount of the most valuable spectrum that is available to trade, as it is allocated to MoD, broadcasting and cellular mobile.

A6.47 In light of the above, the key question is whether AIP can assist efficiency in individual spectrum markets as a complement of trading (and liberalisation). We discuss this in the next section.

Is AIP still needed on tradable licences?

A6.48 Ofcom has previously accepted[99] that there would be no need for AIP if:

- spectrum were a freely and efficiently traded good, with sufficient liquidity and transparency that there was good information in the market about prices, and those prices were a good reflection of market value; and
- all users of spectrum had to acquire the spectrum that they wanted through the market.

A6.49 In that case, we explained, spectrum users would forgo revenue by continuing to hold their rights to the spectrum, and there would be a 'price' associated with holding spectrum on an ongoing basis. This price would reflect the value of that spectrum to other users and uses (i.e. the opportunity cost) and would create incentives for efficient use of the spectrum without the need for AIP.

A6.50 However, we added, in the absence of an efficient market, charging the holders of spectrum an AIP fee is another way of ensuring that those opportunity costs are reflected in decisions made about spectrum use. We discuss below how AIP can then serve as a valuable complement to other market instruments and create opportunities for improved spectrum efficiency.

[98] For ease of reference we have used the term 'market' as convenient shorthand and this is not intended to refer to a relevant economic market.
[99] *Future Pricing of Spectrum Used For Terrestrial Broadcasting. A Statement* (2007), paragraph 3.23. http://www.ofcom.org.uk/consult/condocs/futurepricing/statement/statement.pdf

Role of AIP when licences are tradable

A6.51 Trading alone may not provide sufficient incentives towards efficient spectrum use in individual markets in two main circumstances:

- if it is limited by barriers like transaction costs, coordination problems and/or lack of price information;
- if licensees are more responsive to AIP than to trading.

Transaction costs, lack of price information and coordination problems

A6.52 Trading volume and market liquidity in individual markets have not yet enabled the development of market institutions that would facilitate low-cost, efficient trading activity, such as spectrum brokers or other market intermediaries. It may be too costly for parties to find one another as a result. Lack of price information can also act as a particularly strong barrier to trade. For instance, spectrum users may be uncertain about the value of spectrum or have very different views about its worth. This makes it less likely that they will agree on how to split gains from trade, or the existence of those gains may not be apparent to both parties.

A6.53 In these circumstances, AIP can allow spectrum to be transferred from lower to higher-value users through existing licensees handing back their licences to Ofcom for reassignment to other users. Existing licensees may migrate to frequency bands that attract a lower AIP or may migrate to non-radio based methods of communication.

A6.54 Finally, as discussed above, transaction costs can be large where use is highly coordinated and licences are site-specific, and coordination problems can arise. AIP could, by itself or in combination with other spectrum management tools (such as band re-planning), provide a mechanism for licences in the band to be repackaged by Ofcom and made available for higher-value uses or users, avoiding the cost and hold-ups that often otherwise beset this type of negotiations.

A6.55 More generally, a liquid trading market penalises wasteful use of the spectrum or unproductive hoarding by forcing users to incur an opportunity cost. That cost reflects the revenue that is forgone by not selling the spectrum rights at the market price. Where trading markets are ‘thin’ or licences are not easy to sell due to transaction costs or other barriers, however, this ‘opportunity cost’ may be less visible than a direct, out-of-pocket cost like AIP. In the extreme, if a market is totally illiquid there is no cost in holding on to spectrum – it just can’t be sold.

Users may be less responsive to opportunity cost than to AIP

A6.56 We also note that some commercial and public spectrum users may be less responsive to trading than to AIP. This may be the case, for example, where public sector users are unable to retain the proceeds from spectrum sales. More generally, when strong pressures are put on managers to reduce or contain their operating budgets, but less importance is placed on realising untapped revenue sources such as might arise from selling spectrum, AIP can provide a more powerful incentive for licensees to use spectrum efficiently than the possibility of selling unwanted spectrum.

Arguments against charging AIP for tradable spectrum

A6.57 We now consider the potential negative effects of charging AIP for tradable spectrum. In our Spectrum Trading consultation and in informal submissions to this Review, stakeholders argued that sustaining AIP when licences are tradable is likely to harm efficiency:

- if AIP is adjusted only infrequently there is a risk that the market value of spectrum will fall below the AIP level, so that users will return their licences (leaving idle spectrum) and trading activity will be depressed;
- conversely, if AIP is regularly adjusted to track changing market values it may also deter trades if parties expect their AIP fees to be increased as a result.

A6.58 We agree with our stakeholders that both risks exist and need to be guarded against, but we do not think that the answer is to dispense with AIP. Since the introduction of AIP we have followed a deliberate policy of setting fees conservatively so as not to discourage trading or leave spectrum unused. It is still possible, however, that even with a conservative policy an AIP fee exceeds the market price if it is only revised after several years. In that case, as stakeholders point out, licences will be returned to us and this will act as a signal that the prevailing AIP rate needs to be adjusted.

A6.59 We also recognise in this document (in Annex 7) the perverse incentives that linking AIP directly to auction or trading prices could create and the need to avoid that outcome. In practice, AIP is not instantly adjusted in response to new information on market value and there is always some delay before any relevant AIP fee rate is revised.

A6.60 Accordingly, we do not consider there to be a general argument against the use of AIP when licences are tradable, as the benefits and costs will depend on the circumstances of the specific spectrum trading environment concerned.

Our initial summary

A6.61 In summary, subject to consultation, we believe that:

- there is currently no single spectrum market but rather a set of separate markets across the various frequency bands, and this is likely to continue in the foreseeable future. This points to the need for a separate analysis of each market in future fee rate reviews, and means that the role of AIP as a complement of other market mechanisms may well differ in each individual market;
- trading volumes in individual markets have proven insufficient to provide the market the depth and liquidity required to attract those markets intermediaries that would enable markets to operate more efficiently;
- in addition, trading and liberalisation alone may not be sufficient to promote efficient use in certain spectrum markets, particularly where spectrum use is highly co-ordinated under the current licensing regime – therefore, AIP may need to perform a more important role in such markets;

- in markets where trading and liberalisation have a stronger role to play in the promotion of the efficient use of spectrum, the role of AIP may correspondingly be less critical, but may remain an important complementary incentive to promote the optimal use of spectrum where those markets continue to be imperfect.

Annex 7

Reference rates and the cliff edge

A7.1 In this Annex we explain how we set fees, which is based on two related methods, and provide more detail as to why we propose to move towards one of those methods (termed the 'Indepen method') in our pricing of all applications.

Our current fee methodologies

A7.2 Broadly, we currently apply two different methods in setting AIP fees:

- The Smith NERA method – we inherited from the RA and continue to use a simple method based on a single 'mobile' reference rate in bands used by a group of licence sectors that are deemed to be 'mobile' and another 'fixed' reference rate in bands used by fixed links and other fixed services. AIP rates for each band are then calculated by adjusting each reference rate with a band factor specific to each class (see Case Study 1 below);

- The Indepen method – since our Spectrum Pricing Consultation in 2005[100], in setting fees for new licence sectors we have followed an alternative method recommended by Indepen which generally uses a greater number of reference rates[101].

A7.3 With the Smith NERA method, reference rates are based on the value of spectrum to the existing service (or, in the case of the 'mobile' rate, rates are based on an average of those values[102]), without consideration of alternative uses. To that extent, rates are service-specific.

A7.4 In contrast, the Indepen method takes into account the value of spectrum in both its existing and in potential alternative uses for the band(s). Rates are service-neutral in that they are not solely based on the value of the service(s) which is currently deployed in the band in question.

[100] *Spectrum Pricing. A Statement on Proposals for Setting Wireless Telegraphy Act Licence Fees* (2005), paragraph 2.12. http://www.ofcom.org.uk/consult/condocs/spec_pricing/statement/statement.pdf

[101] For instance, we have recently applied it in making proposals to apply AIP to some maritime and aeronautical licences. This approach was also taken in developing proposals for pricing for PMSE licences, where we propose one rate per band. *Applying Spectrum Pricing to the Maritime Sector, and New Arrangements for the Management of Spectrum Used for Radar and Aeronautical Navigation Aids* (2009). http://www.ofcom.org.uk/consult/condocs/aip_maritime/aipcondoc.pdf . http://www.ofcom.org.uk/consult/condocs/bandmanager09/report2.pdf

[102] The mobile rate is an average of service-specific rates calculated for each service. The Smith NERA (1996) report for the RA estimated four separate reference rates for the cellular and business radio 'mobile' classes (then, PMR/CBS, PAMR, Cellular 900 MHz and Cellular 1800MHz). However, stakeholders were concerned that having four different mobile rates could create market distortions and may favour one kind of mobile service over another. In view of those concerns, the RA averaged the four mobile values into a common 'mobile' rate (then called STU) of £1.65 per MHz per km2. See Radiocommunications Agency. *Implementing Spectrum Pricing* (1997), paragraphs D.4 to D.7. http://www.ofcom.org.uk/static/archive/ra/rahome.htm

Case Study A7.1: the Smith NERA method

Use	*Reference rate*	Unit
Business Radio and Cellular 2G	£1.65	per MHz per km^2
Fixed Links (1.35GHz-57GHz)	£88	per 2x1 MHz for each bi-directional link

The 'mobile' rate

The 'mobile' reference rate of £1.65 per MHz per km^2 is used in business radio, cellular 900MHz and 1800MHz[103] and other applications[104]. The rate equals £9,900 for a 2 x12.5 kHz national channel in business radio or £158,400 per 2 x 200 kHz channel in 2G cellular use[105].

In business radio, the £9,900 rate is adjusted with a band factor of 1, 0.83 or 0.33 (area defined licences) or 1 and 0.83 (technically assigned licences) based on the degree of congestion of different bands.

The 'fixed' rate

The equivalent reference rate for 'fixed' services is £88 per 2x1MHz for each bidirectional link[106]. For fixed links operating between 1.35GHz and 57GHz, the rate is adjusted via a band factor with six possible values (1, 0.74, 0.43, 0.30, 0.26 and 0.17).

The £88 per 2x1MHz fixed rate is also used to derive the reference rate for satellite earth stations and transportable earth stations[107] and in our pricing of Radio Astronomy grants of RSA where bands are shared with fixed services.

Problems with our continued use of only two reference rates

A7.5 There are several problems with our continued use of two reference rates in the pricing of some licence classes. We explain these below, as well as the balancing cost of greater granularity in reference rates and the need to keep pricing algorithms and structures simple.

[103] *Spectrum Pricing. A Statement on Proposals for Setting Wireless Telegraphy Act Licence Fees* (2005), paragraph 3.19.
http://www.ofcom.org.uk/consult/condocs/spec_pricing/statement/statement.pdf
[104] Including scanning telemetry and the Radio Astronomy grants of RSA that share bands with mobile applications. In scanning telemetry, the rate is £7,920 per 2 x 12.5 kHz national channel, which is based on and discounted from the £9,900 rate due to international interference.
[105] Area of UK = 240,000 km^2. Therefore, rate for 2 x 12.5 kHz national channel in business radio = £1.65 x 240,000 x 2 x 0.0125 = £9,900. The rate for a 2x200 kHz national cellular channel = £1.65 x 240,000 x 2 x 0.2 = £158,400
[106] http://www.ofcom.org.uk/consult/condocs/spec_pricing/statement/statement.pdf , paragraph 3.46.
[107] *Modifications to Spectrum Pricing Statement* (2007), Annex 5.
http://www.ofcom.org.uk/consult/condocs/pricing06/statement/statement.pdf

Problems with the two reference rate approach

A7.6 Some problems with the Smith NERA method were highlighted by the Independent Audit of Spectrum Holdings[108]. In essence, a pricing structure based on a 'mobile' and a 'fixed' rate:

- gives rise to a 'cliff edge' in pricing at the boundary between 'fixed' and 'mobile' spectrum that may not reflect true variations in value[109];
- may fail to acknowledge the potential for alternative uses of those specific bands;
- may be inconsistent with our move towards technology and service neutrality, and is at odds with the increasing convergence between 'fixed' and 'mobile' services.

A7.7 To address these issues, the Independent Audit invited Ofcom to address the 'cliff edge' and to move in the longer term to a generic, service-neutral per-MHz pricing system which reflects the spectrum value curve, subject to any relevant restrictions on use[110].

A7.8 Another potential problem concerns the extent to which the Smith NERA method sufficiently captures variations in value between bands, both at the boundary between 'fixed' and 'mobile' bands (as highlighted by the Independent Audit) but also in other parts of the radio spectrum.

A7.9 As we explain in Section 2, the value curve for spectrum can be expected to exhibit numerous discontinuities that we would expect to reflect in AIP fees. We discussed the key drivers of the value of different bands, which include:

- demand for the services currently allocated to the bands by domestic and international allocations, and alternative services that could use that spectrum;
- the degree of international harmonisation and availability of equipment;
- physical properties of propagation and bandwidth;
- other variables, including licence restrictions (e.g. power limits) and other constraints on use of the spectrum.

A7.10 In our AIP methodology, value differences are captured through a combination of the reference rate and the band factor (see Appendix A for further detail). In principle, it is possible to have different combinations of reference rates and band factors to set AIP fees. In general, the smaller the number of reference rates used the wider the range of value differences that the band factor needs to capture.

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[108] *Independent Audit of Spectrum Holdings: An Independent Audit for Her Majesty's Treasury* (December 2005), pages 3, 7, 28, 33, 34 and 82. http://www.spectrumaudit.org.uk/pdf/20051118%20Final%20Formatted%20v9.pdf

[109] Specifically, there is a marked discontinuity at the boundary between spectrum allocated to mobile and fixed applications and a large differential between AIP fees on the lower fixed link bands (1.4 GHz, 4 GHz, lower and upper 6 GHz) and those charged to mobile users below 3 GHz.

[110] *Independent Audit of Spectrum Holdings*, December 2005, recommendation 3.2 at http://www.spectrumaudit.org.uk/pdf/20051118%20Final%20Formatted%20v9.pdf

A7.11 For instance, we could use:

- a single (average) rate for bands used by a group of licence classes, which is then adjusted via a band factor specific to each licence class; as the Smith NERA method does in its pricing of 'mobile' bands;
- a single rate for bands used by a licence class (which may have different alternative uses), which is then adjusted via a band factor; as the Smith NERA method does in its pricing of 'fixed' bands;
- a single rate for those bands used by a licence class which have the same alternative use, with each rate adjusted by a band factor;
- a single rate for each individual band used by a licence class, which obviates the need for a band factor altogether.

A7.12 Table A7.1 shows how in the Smith NERA method the band factor has to capture variations in value caused by most or all key value drivers. For instance, bands used by the business radio and cellular 900 and 1800MHz classes attract the same rate, so the band factor has to capture value differences caused by different existing uses (e.g. between business radio at 138MHz and cellular use at 900MHz), propagation characteristics, degrees of harmonisation or equipment availability.

Table A7.1: capturing key value drivers via the reference rate or the band factor

One single rate for:	Key value driver captured by Reference Rate	Band Factor
1. Bands used by a group of licence classes (as in Smith NERA pricing of 'mobile' classes)		Existing and alternative uses Harmonisation and equipment availability Propagation Other variables
2. Bands used by a single licence class which may have different alternative uses (as in Smith NERA pricing of 'fixed' classes)	Existing uses	Alternative uses Harmonisation and equipment availability Propagation Other variables
3. Bands used by a licence class which have the same alternative use	Existing and alternative uses	Harmonisation and equipment availability Propagation Other variables
4. Each individual band used by a licence class	Existing and alternative uses Harmonisation and equipment availability Propagation Other variables	-

A7.13 In general, the Smith NERA method places a greater a weight on the band factor and, in some circumstances may not capture variations in value with sufficient degree of granularity. Reference rates will normally be able to capture variations in value caused by each of the key value drivers of spectrum more accurately than the band factor. As explained in Appendix A and expanded in this consultation, reference rates can be based on market valuations and least-cost alternative calculations of opportunity cost. In contrast, the band factor can most readily be used to reflect relative differences in value, such as relative levels of congestion in each band.

Cost of greater granularity and the need to keep pricing algorithms simple

A7.14 The above discussion suggests that in some circumstances there would be benefits in making greater use of reference rates in setting AIP fees. However, we need to strike the right balance between:

- on the one hand, reflecting variations in the value of different bands more closely (as recommended by the Independent Audit) and;
- on the other, the cost of obtaining grater granularity in our fees and the need to keep our pricing algorithms as simple as possible, as with the Smith NERA method.

A7.15 When setting AIP fees for licence classes which operate over a large number of bands (such as fixed links or the business radio classes), it is not always proportionate to produce a large number reference rates or, at the extreme, one rate per band. The cost of having greater granularity in our reference rate (in terms of the required resources to do so) can sometimes exceed the expected benefit.

A7.16 Importantly, in the past stakeholders have also said that they found pricing structures like Smith NERA's, based on a small number of reference rates and a band factor ,easier to understand than one based on a large number of reference rates for different bands.

Initial summary

A7.17 All things considered, we agree with the concerns about our continued use of the Smith NERA method in our pricing of some applications. In addition, we think that the use of two reference rates may in some cases place undue weight on the band factor which may not sufficiently capture variations in market value (in the fixed/mobile frontier as well as in other parts of the spectrum).

A7.18 As already summarised in Issue 3, we propose in future to take account of feasible alternative uses where we do not currently do so, in order to move towards a pricing system that better reflects the variations in spectrum value. This will also help address the sharp 'cliff edge' in our pricing of mobile and fixed applications, although some discontinuities in AIP fees (caused by those inherent in spectrum values, as discussed in Section 2) will remain. We will, in applying this principle, continue to aim to keep fee structures simple and transparent – our aim might for example be achieved with a small number of additional reference rates.

A7.19 One potential application of this principle is in our future pricing of spectrum used by business radio. Once licences for cellular mobile at 900 and 1800MHz are

liberalised and tradable, the potential difference in value between this spectrum and spectrum used in business radio might lead us to consider introducing a separate reference rate for business radio, rather than trying to address this difference through a band factor as is currently the case.

Annex 8

Qualitative implications of our proposed principles and methodology in two major licence sectors

A8.1 In this Annex we discuss the qualitative impact that our proposals in this document may have on two major licence sectors: Fixed Links and Business Radio.

A8.2 For each licence sector, we describe the:

- nature of use;
- frequency bands in use;
- primary allocation and assignment process;
- secondary assignment process;
- current spectrum pricing structure,
- implications of our proposals.

A8.3 However, it should be recognised that as any fee for a specific licence in practice would be set on the basis of the combination of these principles, it is very difficult, if not impossible, to predict what the specific change to any fee level might be. In particular, the outcome of a re-estimated of the opportunity cost of the spectrum may swamp the effects of all of the other principles.

Fixed Links

Nature of the Fixed Service sector

A8.4 Fixed Services is a general term used to describe a terrestrial based radio application/system – as opposed to a mobile service – comprised of stations that do not move, as opposed to the mobile service in which some stations move and so signal coverage needs to include the area within which they move.

A8.5 A point to point link (PTP) is a fixed service which provides connectivity between two stations or sites by radio. Point-to-point fixed links were first deployed around fifty years ago to distribute broadcast signals and provide ‘trunking’ between towns and cities in the public telephone network; numbers of links are still used for these purposes today. Links may be also used to connect networks directly to customer premises but the vast majority of new links deployed are for provision of essential infrastructure in the mobile networks, for example to connect cellular base stations to the operator’s core network. Around 40,000 links are currently licensed in the UK.

A8.6 PTP fixed link licensees come from a wide cross section of industry sectors, ranging from large telecommunications companies, through the main mobile network

operators, utilities, district/local councils and down to smaller independent companies.

Frequency bands in use

A8.7 PTP links are mainly licensed in frequency bands above 3 GHz as these frequencies are more suitable to support the large bandwidth channels that PTP links require to support high data rates to be transmitted, and allow the use of highly directional antennas, which means that it is possible to co-ordinate sharing by a large number of uses compared with lower frequencies. The following bands are used in the UK for point to point, Ofcom co-ordinated fixed links:

Band	Number of licenses (Jan10)	Note
1.4 GHz	902	1.3 GHz to 1.5 GHz
1.5 GHz	5	Closed for new assignments
1.8 GHz	137	Closed for new assignments
2 GHz	15	Closed for new assignments
4 GHz	41	3.6 GHz to 4.2 GHz
Lower 6 GHz	220	5.9 GHz to 6.4 GHz
Upper 6 GHz	333	6.4 GHz to 7.1 GHz
7.5 GHz	1111	7.4 GHz to 7.9 GHz
11 GHz	60	Closed for new assignments.
13 GHz	3995	12.7 GHz to 13.2 GHz
14 GHz	363	Closed for new assignments.
15 GHz	2033	14.5 GHz to 15.3 GHz
18 GHz	8409	17.7 GHz to 19.7 GHz
23 GHz	6278	22 GHz to 23.6 GHz
26 GHz	3760	24.5 GHz to 26.5 GHz
38 GHz	13547	37 GHz to 39.5 GHz
50 GHz	67	Closed for assignments
52 GHz	0	51.4 GHz to 52.6 GHz
55 GHz	0	55.78 GHz to 57.0 GHz

A8.8 In addition, the 31 GHz band is available for PTP security CCTV links, and the 65 GHz, 75 GHz and 85 GHz bands are available for self-coordinated fixed links. . A further band (currently called the 58GHz band) is also available on a licence exempt basis.

Primary allocation and assignment process

A8.9 There are no international agreements that mandate fixed services in any given band. However, there are a number of technical and regulatory constraints that are applied within the Radio Regulations that set the overall framework in which fixed links operate. The terrestrial fixed service appears as primary services in a number of bands in the ITU Radio Regulations and these bands are the basis of fixed link use in the UK and most countries. In addition, the ITU and ECC/CEPT have issued recommendations on channel arrangements and propagation models that are broadly followed in the UK.

A8.10 As with most radio communications services, the allocation of a new band to fixed links normally happens after agreement at international level at the ITU – either on a Primary or Secondary Basis. Many bands allocated to the fixed service are also shared on a Primary basis with the satellite service. New assignments of point to point fixed links are subject to robust frequency assignment procedures. The candidate link is coordinated with the established set of links and with satellite earth stations in shared bands. Frequency assignment procedures are designed to support the high availability levels required by the service (typically 99.99% propagation availability) and to protect receivers from harmful interference. Ofcom runs technical procedures and issues licences on a first come first served basis.

A8.11 Ofcom provided fixed links are assigned on a first come, first served basis.

Secondary assignment process

A8.12 Fixed link licences are liberalised and tradable since 2004. These two changes increase users' choices over how to use their spectrum, but the nature of fixed link use means that some essential limitations remain on changes of use, and as discussed in Annex 6 trading may not be the best (or even a possible) means for new users to gain access to spectrum. These aspects of fixed link use and planning are discussed below.

A8.13 If a licensee wishes to use the flexibility offered by liberalisation, Ofcom must carry out a coordination assessment each time a licensee wishes to change one of the parameters of its link. If the variation will not cause undue interference to existing users (including those in an alternative use sharing the band), the licence will be amended as needed, and there will be a fee update to reflect the new assignment characteristics, as relevant.

Spectrum Pricing

A8.14 The fees currently charged for point to point links are based on AIP for all bands between 1.35-57 GHz and all geographical locations. There is no administrative cost floor at present and the AIP fee algorithm does not incorporate a location factor to capture geographical variations in congestion. The fee algorithm is based on a reference rate or 'spectrum price', modified to account for the amount of spectrum used and spectrum management principles according to the algorithm below.

Fixed link licence fee =	Spectrum Price × Band Width Factor × Band Factor × Path Length Factor x Availability Factor x (Adjustments)
Where: **Spectrum Price**	 Price for each unit of link bandwidth: £88 per 2 x 1 MHz. This spectrum price was developed from fixed links own use i.e. no alternative use
Band Width Factor	Directly proportional to the link bandwidth in MHz, but with a minimum value of 1.
Band Factor	Adjusts the licence fee to encourage a general use of higher bands
Path Length Factor	Adjusts licence fee to encourage short links to move to higher bands thus retaining lower bands for longer links that would not be technically possible in the higher bands. Links shorter than the minimum path length are charged a premium
Availability Factor	Higher availability requires higher radiated power levels, which has an opportunity cost for other users
Additional adjustments	Fixed PTP links that are added, during or after the issue of the licence, and that operate on a co-channel and cross-polar basis to the original, will be subject to 50 per cent of the sum. Uni-directional links (i.e. a link that transmits in one direction only), will be subject to 75 per cent of the fee.

Implications of the SRSP proposals for any fixed link fees review

A8.15 The proposals that we believe could have an impact on fixed link fees are:

- The refinements to the assessment of feasible alternative use;
- The assessment of congestion, including the increased focus on geographical variations in demand;
- Refinements in how we will estimate spectrum value; and
- The characteristics of fee structures and algorithms.

A8.16 Each of these is discussed in turn in the next sections.

Assessment of feasible alternative use

A8.17 Fixed links have traditionally shared bands with satellite use because interference between these uses can be efficiently managed. Downlink satellite transmissions are set by international agreement to power levels that avoid interference to fixed links – which themselves generally have highly directive antennas not pointing to the satellite. Interference mitigation between fixed links transmitters and satellite earth stations in a country is addressed by the national spectrum manager – Ofcom in the UK – normally through coordination. Satellite earth stations have traditionally been few and stationary, making the coordination exercise manageable.

A8.18 However, developments in satellite services have moved towards smaller size, mobile earth stations meaning that coordination – and therefore band co-existence – with fixed links may become impractical. This has been the reason of the closure for PTP usage of a number of bands and, in the future, may give an indication that an alternative use, which puts a different value on spectrum, could appear in certain fixed service bands.

A8.19 The Independent Audit of Spectrum Holdings and a consultancy report have suggested[111] that the lower frequency PTP bands could be used for mobile services and so fees should reflect that fact. However, a key element of the feasibility of mobile use is the level of harmonisation of a band. For instance, spectrum that in the UK is used for PTP links at 1.4 GHz is allocated in Japan to mobile services. However, in Europe and other Regions we are not aware of any initiatives to allocate these frequencies to mobile use.

A8.20 On the other hand, the 3.4 GHz to 3.8 GHz range has recently been subject to a European Commission Harmonisation Decision for Broadband Wireless systems. This range overlaps with the lower part of the 4 GHz PTP band which starts at 3.6 GHz. On the current evidence, and subject to a full analysis of demand factors, a future fee review for fixed links would need to consider Broadband Wireless as a potential alternative use for this band over the relevant timeframe; this may have an impact on the reference rate for this band.

Assessment of congestion

A8.21 A number of submissions to the SRSP and consultancy studies have questioned the need for AIP in view of apparently low levels of congestion in the higher fixed link bands. Other submissions have requested that the fixed links algorithm differentiates between geographical locations on the basis of congestion[112]. In our Spectrum Pricing Statement, we agreed with stakeholders that a lower fee in certain remote rural locations might be appropriate, and said that we would publish our proposals in the next pricing consultation for fixed links.

A8.22 To address these points, a future fixed link review would need to consider whether all fixed links bands in the 1.35 - 57GHz range should continue to be subject to AIP or whether some should attract a cost-based fee instead. We would also consider whether the fixed link algorithm can in practice incorporate a location factor to recognise geographical variations in congestion, in view of the difficulties explained in Appendix A.

A8.23 Preliminary analysis indicates significant differences in congestion on a geographic and frequency basis that, under the revised Framework that we are consulting on, we should attempt to reflect in fees in any future review. On the frequency

[111] *Independent Audit of Spectrum Holdings: An Independent Audit for Her Majesty's Treasury* (December 2005), pages 3 and 28.
http://www.spectrumaudit.org.uk/pdf/20051118%20Final%20Formatted%20v9.pdf
Study into the Use of Spectrum Pricing' (1996), Section 3.7.3.
http://www.ofcom.org.uk/static/archive/ra/topics/spectrum-price/documents/smith/smith1.htm

[112] For instance, see *First Intellect Submission to Ofcom's Spectrum Pricing Review: Principles and Formulas for Fixed Links Fees*, page 2.
http://www.intellectuk.org/component/option,com_docman/task,cat_view/gid,258/dir,DESC/order,date/limit,10/limitstart,10/ Plum, *Estimating the Commercial Trading Value of Spectrum* (2009), page 66.
http://www.ofcom.org.uk/research/technology/research/spec_future/specestimate/specestimate.pdf

dimension, it appears clear that certain bands are less congested than others even after normalisation for band size and assignment bandwidth. For example the high frequency bands used by mobile operators are generally seen as non-congested: propagation distances are shorter and this allows a high re-utilisation factor, and the bands are very wide and can accommodate several high data rate channels. If we conclude that high frequency bands are not sufficiently congested to warrant a fee based on AIP, then a fee level that reflected our administrative costs would be appropriate.

A8.24 However, looking at the number of links per band nationwide only gives a national average indicator of congestion. Actual congestion occurs at specific sites where capacity can be measured not only in terms of numbers of frequencies available but by reference to certain technical characteristics of assignments (since assignments may be planned and co-ordinated to permit multiple installations at or around a single site). Geographically, we note that usage is dense in high population areas and certain busy sites (along highways, on hills). A possible explanation is that certain high frequency bands are used as the backbone that connects mobile base station sites with the operator core network – hence the correlation with population; other bands are used for long haul pipelines that are deployed where fibre is not practical or feasible. In this scenario the link ends would tend to concentrate in sites that present an advantage such as an existing mast, easy access to a power network or good propagation conditions.

A8.25 While it would be possible to consider the population-related congestion in the fee structure – this element is already part of the Business Radio fee – the busy site effect appears, on initial analysis, more difficult to factor in. Appendix A explains the difficulties we have experienced in the past when attempting to measure geographical congestion in fixed links.

A8.26 In practice, evidence of the relative levels of congestion of bands is likely to be most obvious in our licensing operations. Present and future levels of congestion might be gauged through the number of applications received and the evolution of the number of licences per band and geographical area. However, stakeholders have stated that fixed link operators are likely to have better forecasts of future demand than Ofcom's internal licence data.

Refinements to how we estimate spectrum value

A8.27 Under our proposals, reference rates and band factors would be recalculated taking into account any relevant market data where available. At present, price information from trades is not disclosed to us, so only auction results are available. In particular, the 2008 award of spectrum in the 10 GHz, 28GHz, 32 GHz and 40 GHz band could be used if appropriate. As highlighted by stakeholders[113], a quick analysis of the prices paid in this auction may suggest that the current reference rate is high when compared with the auction price. However, there are a number of factors that we would need to assess in order to determine how directly we could use such data to set reference rates, as we explain in Section 3.

A8.28 Further, we are proposing to increase the number of reference rates, where appropriate, with lesser reliance on the band factor. In practice this means that we

[113] *First Intellect Submission to Ofcom's Spectrum Pricing Review: Principles and Formulas for Fixed Links Fees*, page 2.

may have two rates for the fixed link bands, depending on our assessment of the feasibility or not of alternative uses (including mobile) in some of the lower bands as explained above.

The characteristics of fee structures and algorithms

A8.29 In this consultation we propose to continue setting AIP fees for individual assignments through an algorithm or fees structure that combines the reference rate and factors that reflect the amount of spectrum used and reflecting changes in the value of the reference rate. This is broadly in line with our current PTP fee algorithm described above. Nevertheless, the algorithm could be refined as follows:

- We are proposing to consider a 'location factor' in future fee reviews, to capture the value of the spectrum at the specific location at which the user operates, as mentioned above.

- We are proposing to continue using, as a general element of pricing, a factor proportional to the area in which other assignments are excluded or limited, to enable the service. Appendix A explains that it is not possible to simply define an 'area sterilised' in fixed links. The availability factor in the current algorithm does, to some extent, account for this effect since availability is one of the parameters that determine the extent to which one use affects the interference environment in an area, in turn affecting the ability for other users to access spectrum in that area.

- Finally, in considering a new fee structure we would review existing elements of the algorithm to ensure these reflect our principles and methodology. Reviewing the current algorithm would involve consideration of the minimum path length factor, which some stakeholders think redundant. Since its purpose is to encourage use of higher frequency over lower frequency bands when long distance transmission is not required, it effectively reflects a particular element of value (long propagation distances) that only lower bands have. In principle, as stakeholders have argued, this element of value could be captured by the band factor instead. We would need to consider the effects of such a change on incentives for optimal use of the spectrum before proposing it, including the effects on current users in lower bands who have longer links.

Business Radio (BR)

Nature of Business Radio sector

A8.30 Business radio covers many services and applications with the common characteristic of providing private communications that are terrestrial (i.e. not satellite) and mobile. Business radio systems emerged to support dispatching services and the management of fleets of vehicles, often for utilities and emergency services. They were initially referred to as private mobile radio or private business radio systems, to highlight that they provided 'private networks', that is, used by companies to support their business or service, and not offered as an end service to consumers, in contrast to the public mobile telecommunication networks.

A8.31 Business radio today has grown to carry both voice and data. The model of use is still one providing a mobile coverage to a community of mobile terminals to support communications between these terminals and usually with one or more fixed sites

(e.g. a cab being given its next pick-up by one or more cab offices). BR licences cover geographical areas from a few hundreds of square metres to the whole country.

A8.32 Business Radio users come from a large range of sectors. Examples of organisations that rely on private mobile radio systems for their day to day operations include utilities with large, proprietary networks, emergency services, delivery and taxicab companies, and security organisations.

Frequency bands in use

A8.33 Several frequency bands are used by Business Radio, the bands in the VHF and UHF ranges form the core of the Ofcom's business radio licence classes. The table below summarizes these bands and its current usage.

Table 3: Business radio licences by frequency band and type of licence

Band	Paging	VHF Band I	VHF Low	VHF Mid	VHF High	VHF Band III	UHF Band I	UHF Band II
Frequency Range (MHz)	26.22 – 49.49	55.75– 68.00	68.08– 87.49	137.96– 165.04	165.04– 173.09	177.20– 207.49	410.00– 449.49	453.00– 466.08
Technically Assigned licences Total: 29852	397	91	893	1390	11097	128	3461	12395
Area Defined licences Total: 70			3	19	7	1	3	37
Light Licences	13510							
Charging category	Low Usage	Admin fee	Low Usage	Medium Usage	High Usage	Medium Usage	High Usage	High Usage

A8.34 In addition to these, there are Business Radio allocations at Low Frequency band (132.977 – 133.977 kHz & 146.205 – 147.205 kHz) and also for the GSM Railways band (876 - 880 MHz & 921 - 925 MHz).

Primary allocation and assignment process

A8.35 The licensing scheme for Business Radio was restructured in 2007 when more than 20 licence types where rationalised into three new classes:

- Area defined: licensees have the right to deploy as many transmitters as they wish in a defined area, which can be very large i.e. the whole UK or a nation, or a specific smaller area, assigned on the basis of 50 km x 50 km grid squares;
- Technically assigned: Ofcom manages the deployment of each individual transmitter to ensure that interference to all licensees is kept to acceptable limits;
- Light licensing: Licensees have access to a number of channels on a non-coordinated and non-protected basis. Spectrum is therefore 'pre-packaged' and not subject to individual co-ordination.

A8.36 Table 3 above gives a snapshot of the number of licences in each class as of February 2010.

Secondary assignment process

A8.37 Before the latest restructuring of BR licences some licences were tradable. However, all BR licences were made tradable with the introduction of the new licence class structure in January 2009 and this has resulted in a significant increase in the number of trades.

Spectrum Pricing

A8.1 Fees for Area Defined and Technically Assigned licences are based on the 'mobile' reference rate, modified to account for various factors. Specifically, fees for both licences types are based on an AIP based Reference Rate of £9,900 per 2 x 12.5 kHz national channel modified by band factor and a population factor as follows:

- Frequency bands are grouped into 3 categories - Highly Popular, Medium Popular and Less Popular;
- The UK area is divided in a grid of 50 km × 50 km units which are characterised by their population into three categories: high, medium and low population. In addition to the 50 km × 50 km units, licences are available UK-wide, GB-wide and nation-wide. Fees are apportioned to the national channel rate in proportion to the population within the nations (Wales, England, Scotland and Northern Ireland).

A8.2 Fees for a Technically Assigned Licence depend also on coverage and whether the frequencies are shared or not. Transmitted power and antenna height are used to proxy for coverage, and a 50% reduction is applied to shared assignments.

A8.3 There is a minimum fee of £75 for any Area Defined or Technically Assigned licence.

A8.4 Light licence fees are flat and intended to contribute to spectrum management costs. Fees are charged at a simple, flat rate of £75 per 5 years, per site or, where no base station is deployed in the licensed use, per licence.

A8.5 In 2009 we consulted on the fees that we charge for Business Radio licences between 55.750 MHz and 68 MHz (Band I). We commissioned a study to assess the level of congestion, and it was found that all existing uses and currently envisaged future uses for this band could be accommodated in the existing spectrum. This was largely because the spectrum is subject to severe restrictions in use under international co-ordination requirements, which in turn limits the range and number of uses and users who would wish to use it. Given the lack of congestion in the band, the opportunity cost was estimated as zero and our proposal was that the fees should be reduced to levels which made a contribution to our administrative costs. We issued a Statement in 2009 outlining our conclusions[114].

[114] http://www.ofcom.org.uk/consult/condocs/bandi/

Implications of key SRSP proposals for business radio fees

A8.6 The proposals that we believe could have an impact on BR fees are:

- The increased focus on variations in demand;
- Refinements in how we will estimate spectrum value; and
- The characteristics of fee structures and algorithms.

A8.7 Each of these is discussed in turn in the next sections.

Increased focus on variations in demand

A8.8 We explain in Section 4 that we propose to use levels of congestion as a proxy for excess demand in existing use and we propose a systematic assessment of congestion on a band by band and geographic basis. This approach was used when we recently restructured BR licences and fees and therefore it is likely that any future fee review would only need to look at the benefits of refining this approach with a higher degree of granularity in the definition of the bands and geography.

A8.9 We also propose in this document that cost based charges should form the minimum fee in any AIP fee structure. In the main, this approach is already incorporated to current BR charges. In our low usage bands and low population areas, a flat fee of £75 is charged.

Refinements to how we estimate spectrum value

A8.10 We also propose in this document some enhancements to the way we estimate spectrum value i.e. how we calculate the reference rate. Notably, we suggest that market data – where available – would be taken into account and that where appropriate we should consider the merits of increasing the number of reference rates.

A8.11 At present we do not require parties in a trade to disclose to us the agreed price (they can do so voluntarily) and therefore we do not currently hold information regarding trading prices.

A8.12 We awarded 4 MHz of UHF spectrum in 2006 through a competitive auction (The 412-414 paired with 422-424 MHz award). The spectrum awarded is close in frequency to the BR bands and therefore in any future fee rate review we consider the merits of using the auction outcome to inform our understanding of the value of the spectrum used by BR licences.

A8.13 Current AIP fees in BR are based on the ‘mobile‘ reference rate. The key outcome of our proposal to consider the merits of increasing the number of reference rates as discussed in more detail in Annex 7 is the possibility of decoupling the business radio reference rate from the cellular 900 and 1800MHz reference rate, particularly if these fees increases significantly to reflect the increase in value arising from liberalisation.

Characteristics of fee structures and algorithms

A8.14 Our proposal is to continue to base individual licence fees on the relevant reference rate modified to take account of spectrum that is not denied to other users, and the differences in the value of spectrum by geography and frequency. We propose in Section 4 to continue using fee structures that reflect the general AIP algorithm as follows:

AIP fee = reference rate x bandwidth x area sterilised x sharing x band factor x location factor

A8.15 The current fee structure in Business Radio is well aligned with this algorithm. In particular, it takes account of the location by means of the High/Medium/Low Population categories in Technically Assigned licences, and by the charges for individual nations in Area Defined licences. It includes a band factor in the categories of Highly Popular, Medium Popular and Less Popular bands. Area sterilised is also represented by the coverage factor (which is a misnomer, since the factor attempts to reflect area denied rather than coverage area of the services provided[115]). Reference rate, bandwidth and sharing are also included in the fee structure. Therefore, modifications to the current fee schema under any future review would be likely to consist of refinements to these factors rather than removing or introducing new factors.

SRSP template **Fee =**		**Current BR charging for technically assigned licences**
Reference rate x	→	Rates are based on the mobile Reference Rate (£9900 for a 2x12.5KHz channel nationwide)
Band factor x	→	Band usage (Highly Popular, Medium Popular and Less Popular bands)
Location factor x	→	Population (High, Medium & Low population areas in Technically Assigned licences and charges for individual nations or trading units in Area Defined licences)
Bandwidth x	→	Charges are for multiple of 6.25KHz channel
Area sterilised x	→	Area denied. ERP and antenna height used as proxies
Exclusive/shared use	→	Reduction of 50% when channel is shared
Subject to a minimum fee set by reference to our costs	→	Minimum £75 fee per licence

[115] Modifications to Spectrum Pricing Statement (2007), paragraph 3.22. http://www.ofcom.org.uk/consult/condocs/pricing06/statement/statement.pdf

Annex 9

Glossary

AIP	Administered incentive pricing – setting charges for spectrum holdings to reflect the value of the spectrum in order to promote optimal use of spectrum
Allocation	Use of a frequency band. Entry in the table of frequency allocations of a given frequency band for the purpose of its use by one or more terrestrial or space radio communications services or the radio astronomy service under specified conditions. This term is also applied to the frequency band concerned
Assignment	Authorisation given by an administration for a radio station to use a radio frequency or radio frequency channel under specified conditions
Avoidable cost	The cost that would not be incurred if the activity in question ceased
Band re-planning	Revising assignments in a band to release a block of spectrum
Band sharing	Fitting a new use in a band in the 'white spaces' between assignments for the existing use
BIS	Department for Business, Innovation and Skills
CEPT	European Conference of Postal and Telecommunications Administrations: a body of national policy-makers and regulators in the telecoms and postal sectors which co-operate on regulatory and technical standardisation issues, including harmonisation within their field of responsibility
EPSS	Emergency and public safety services
ETSI	European Telecommunications Standards Institute
EU	European Union
Exemption	Exemption from the requirement to hold a licence in order to use specified radio equipment, granted by Ofcom under regulations
Frequency Band	A defined range of frequencies that may be allocated for a particular radio service, or shared between radio services
GHz	Gigahertz – unit of frequency equal to one thousand MHz
Harmonisation	The identification of common frequency bands throughout a region (e.g. Europe) for a particular application and, in some cases, technology
Hz	Basic unit of frequency – one hertz is equivalent to one cycle per second
IA	Impact Assessment
Interference	Unwanted disturbance caused in a radio receiver or other electrical circuit by electromagnetic radiation emitted from an external source

ITU	International Telecommunication Union - the United Nations agency for information and communication technology responsible for developing and publishing the international Radio Regulations
MoD	Ministry of Defence
MHz	Megahertz – unit of frequency equal to one million Hz
Ofcom	Office of Communications. Ofcom is the independent regulator for the UK communications industries, with responsibilities across television, radio, telecommunications and wireless communications services
Opportunity cost	The cost of a decision or choice in terms of the benefits which would have been received from the most valuable of the alternatives that was foregone
Radio Regulations	International Radio Regulations made by the ITU, which have the status and force of a treaty, allocate frequencies globally to various applications and deal with cross-border interference
Radio spectrum	The portion of the electromagnetic spectrum below 3000 GHz used for radiocommunications
RSA	Recognised Spectrum Access
Spectrum	The range of electromagnetic radio frequencies from LF frequencies to x-rays and gamma rays
Spectrum liberalisation	Removal of unnecessary restrictions from licences and RSA to allow holders greater flexibility to change how they use spectrum
Spectrum trading	Ability of spectrum users to transfer rights and obligations under spectrum licences or grants of RSA to another person in accordance with regulations made by Ofcom