Spectrum Trading Consultation

This document seeks your comments on proposals to introduce Spectrum Trading and to allow Wireless Telegraphy Act licence conditions to be changed.

November 2003

Closing date for responses: Friday 13th February 2004

RADIOCOMMUNICATIONS AGENCY

Ofcom
OFFICE OF COMMUNICATIONS

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Section 1

Executive Summary

1.1 Ofcom is proposing to introduce spectrum trading. This consultation document sets out our proposals.

1.2 Spectrum trading has been considered extensively in this country in recent years, beginning with the Review of Radio Spectrum Management (the 'Cave Review') in March 2002, leading on to the consultation entitled 'Implementing Spectrum Trading' undertaken by the Radiocommunications Agency (RA) in July 2002. The introduction of trading fulfils a Government commitment made in its response to the Cave Review in October 2002.

1.3 Ofcom is proposing two policies; spectrum trading, and liberalisation of spectrum use. Spectrum trading will allow holders of Wireless Telegraphy Act (WT Act) licences to buy and sell all or part of their rights to use spectrum. Trading may involve the outright transfer of rights and obligations in relation to spectrum use, or a range of other arrangements including leases and hires. Liberalisation of spectrum use will provide a mechanism for licensees to change the use of their licensed spectrum, subject to some constraints.

1.4 Today, the use of spectrum is restricted to particular licensees, who are only permitted to use it for particular uses. In future, the combination of trading and liberalisation of spectrum use will enable spectrum to be used by those who value it most, and for those uses that offer most value. At the same time, access to spectrum for public services will be protected by necessary safeguards. In this way, trading and liberalisation of spectrum use will enable spectrum to migrate towards applications and users providing the greatest benefit to the economy and society. They will help optimise use of the finite spectrum resource for the benefit of UK consumers and citizens. In particular Ofcom believes these policies will yield substantial benefits through:

- faster access to new technologies;
- cheaper prices for the most popular wireless services; and
- greater choice and greater competition for wireless services.

1.5 Spectrum trading is a far-reaching new approach to spectrum management. However, it may be insufficient alone to address all the complex requirements of spectrum usage. As such, Ofcom will use it in combination with other approaches to spectrum management where this is required. In addition, Ofcom is open-minded about alternative approaches to spectrum management that may emerge in future, such as the adoption of a 'spectrum commons' approach. The proposals in this document seek to allow alternative approaches to emerge in future if they become appropriate.

1.6 Ofcom proposes to introduce trading and the liberalisation of spectrum use quickly and pragmatically, consistent with its statutory duties and powers. It will do so in a way that takes due account of existing licensees' rights to spectrum use, and recognises a number of considerations which will affect the extent and speed of change. These factors include international constraints, such as international co-ordination agreements and harmonisation arrangements, domestic policy considerations, and constraints which may arise from the physical characteristics of the spectrum, including interference management and co-ordination processes.

1.7 With some exceptions, such as on-board aviation and maritime frequencies, Ofcom regards most types of rights to use spectrum as tradable in principle. Licence exempt spectrum is also not tradable, and Ofcom may designate more spectrum as licence exempt in future as technology evolves. Having considered the current situation of

spectrum in the UK and its statutory duties, Ofcom is proposing a progressive roll-out of trading, and liberalisation, band by band, over a four-year period.

1.8 To allow trading and liberalisation of spectrum use to take place, Ofcom is proposing making certain amendments to current WT Act licences, and issuing policy guidance affecting them. At present, the majority of licences are annually renewable or may be revoked on relatively short notice, and are tightly defined in terms of the radio equipment and nature of transmission. In future, where possible, Ofcom proposes to amend licences or issue policy guidance to make licences more akin to tradable assets:

- by defining transmission rights more flexibly, in terms of emission levels at the boundaries of licences (geographical and/or frequency boundaries), without reference to specific technologies;
- by publishing a guidance level of interference for each licence class, and defining a mechanism for dealing with any undue interference that a licensee may experience from other authorised users; and
- by defining an explicit notice period, of five years in most cases, that Ofcom would give before the licence could be terminated (with some exceptions).

1.9 Although it cannot fetter its ability to carry out its duties in relation to spectrum management, Ofcom recognises that it needs to provide guidance about the grounds upon which it may serve notice of termination on licensees, in order to provide certainty for making investment decisions. In addition, Ofcom is not proposing to change the licence term of licences that have been auctioned or awarded by other forms of public competition.

1.10 Parties to spectrum trades will be required to register most kinds of trade with Ofcom, who would then update the Spectrum Registry accordingly. Ofcom proposes to make this process as simple as possible.

1.11 Ofcom is proposing to liberalise spectrum use by providing a mechanism for licensees to reconfigure their licences, or change their use. However, Ofcom has certain duties to manage interference which require that proposed changes to the rights and obligations under WT Act licences will need to be approved by Ofcom. Therefore, Ofcom is proposing a two stage process. Ofcom will issue guidance on the extent of reconfiguration and change of use it would in principle permit for each licence class. Licensees will then need Ofcom's approval for specific proposals. They will be required to demonstrate that any proposed change is consistent with the terms of their licence restricting their rights to transmit, and does not cause undue interference to other users. Before approving a change, Ofcom will ensure that the proposed change does not conflict with the UK's obligations to its neighbours under international co-ordination agreements, with any directions given by the Secretary of State, and in some cases with public policies Ofcom has adopted in accordance with its statutory duties.

1.12 Ofcom will continue to police interference through investigation of complaints and enforcement of legislation relating to unlawful acts, as the RA does today. However, a trading environment is likely to result in new types of dispute. Ofcom therefore proposes to use a dispute resolution procedure which encourages negotiation between affected parties as the primary means of resolving disputes, but which provides for Ofcom to adjudicate in disputes where a solution cannot be reached through mutual agreement.

1.13 Ofcom proposes to publish a register of licensing information in order to facilitate trading. In addition, further detail may be available on request, for example to facilitate an assessment of a prospective change of use. Ofcom will not provide information regarding willingness to buy or sell, or information about individual trades. Ofcom will not provide an exchange nor act as a participant in the market, other than through releasing primary assignments, typically by auctions.

1.14 Ofcom anticipates that a range of market participants may emerge. These may include brokers registering intentions to buy and sell, market makers who hold inventories to provide liquidity in the spectrum market, and primary licensees offering surplus spectrum to third parties under a range of agreements. In addition, spectrum management organisations may emerge to manage blocks of spectrum with particularly complex or dynamic spectrum requirements. Ofcom will regulate all participants in trading, be they intermediaries or licence holders, by requiring compliance with a set of Trading Regulations.

1.15 Ofcom will seek to ensure that competition is not distorted as a result of spectrum trading transactions. As a competition authority, Ofcom could take action against anti-competitive behaviour under the Competition Act, which provides wide powers to prohibit the abuse of a dominant position. However, in practice particular features of spectrum may make abuses hard to identify and to remedy. Furthermore, the Competition Act could not prevent the acquisition of positions of market power through spectrum trading. In most markets, the merger provisions of the Enterprise Act prevent firms from acquiring positions of market power. Where these can apply to spectrum trading, they will apply. However, because in most cases spectrum would not be considered an 'enterprise', the Enterprise Act may often not apply to spectrum trades. Therefore, Ofcom proposes to adopt a specific set of rules on the acquisition of rights to use spectrum to ensure that competition distortions do not emerge as a result of trading. Ofcom proposes to adopt an approach that similar to the rules on mergers of enterprises. When certain threshold criteria are met, Ofcom proposes to consider whether a trade might result in a substantial lessening of competition within any market.

1.16 The introduction of a system of spectrum trading is just one of the mechanisms Ofcom will use to carry out spectrum management. It will continue to use market methods such as auctions in making primary assignments of spectrum. It will continue to exempt blocks of spectrum from licensing where appropriate. In addition, there will be occasions when a more administrative approach to the management of spectrum may be appropriate.

1.17 It also proposes to continue to use administrative incentive pricing, alongside spectrum trading. Ofcom believes spectrum trading and administrative incentive pricing to be complementary in encouraging the release of spectrum to the most economic uses. However, Ofcom recognises that the administrative incentive price regime needs to change to reflect a spectrum trading environment, for example by adoption of a predictable review timetable.

1.18 The range and complexity of the issues in spectrum management are such that this consultation document is long and detailed. Ofcom has attempted to be clear about the proposals, and to present a single proposal on each point rather than a range of options. However, the fact that the proposals are singular should not be interpreted as Ofcom having made its decisions. Ofcom remains open-minded to your views and to alternatives.

1.19 Implementing spectrum trading will be a complex and costly process for Ofcom. Ofcom will be carrying out detailed implementation planning in early 2004 and will use this consultation as an important input into this plan. During 2004, Ofcom expects to consult further on specific aspects of spectrum trading, for example, dispute resolution procedures or competition policy measures.

1.20 Spectrum trading is not an end in itself. A well designed system of trading has the potential to yield substantial benefits to the UK economy and its consumers and citizens. But a poorly designed system could impede the management of the radio spectrum. Your views are sought into the design of the trading system so that the benefits can be realised and the risks avoided and mitigated.

Section 2

Ofcom

2.1 Ofcom ('the Office of Communications') is the new regulator of the communications sector. Under the terms of the Communications Act 2003 and the Office of Communications Act 2002 , it will take over the responsibilities of the Director General of Telecommunications (and his office, Oftel), the Independent Television Commission, the Radio Authority, the Radiocommunications Agency (RA) and the Broadcasting Standards Commission. Ofcom will take over responsibility for Wireless Telegraphy (WT) Act licensing from the Secretary of State (and exercised through the Radiocommunications Agency), in December 2003.

2.2 Ofcom and the RA are jointly issuing this consultation document, however the RA will remain responsible for spectrum management until the remaining provisions of the Communications Act come into force in December 2003.

Section 3

Responses to this Consultation Document

3.1 How to respond

3.1.1 This consultation document seeks views on Ofcom's plans for the introduction of spectrum trading. In its policy development Ofcom has taken into account inputs from the Radiocommunication Agency's (RA's) July 2002 consultation, informal bilateral meetings with stakeholders, and a workshop with industry in September 2003. The responses to this consultation will be used to inform development of Ofcom's detailed policy design.

3.1.2 This consultation document is addressed to all organisations and individuals who have an interest in radio spectrum trading in the UK. This includes, amongst others:

- holders of Wireless Telegraphy Act (WT Act) licences, including large companies such as mobile network operators, and smaller organisations such as courier companies using a private business radio service;
- other users of the radio spectrum, such as scientific organisations or providers of satellite downlink services;
- entrepreneurs and other new entrants seeking access to the radio spectrum to offer new or innovative services;
- organisations or individuals interested in participating in trading, for example as market makers, brokers, or information providers; and
- users of radio equipment including citizens and consumers and groups representing consumers.

3.1.3 A summary version of this consultation document, *Ofcom Consultation on Spectrum Trading – A Summary*, has been published in parallel, directed at smaller organisations who do not have time to read this more detailed document.

3.1.4 Printed copies of this document or the summary document may be requested from Ofcom's website, **www.ofcom.org.uk.**

3.1.5 Please send written responses by **Friday 13th February 2004 to:**

Spectrum Trading Consultation
Ofcom
Riverside House
2a Southwark Bridge Road
London SE1 9HA
email: **spectrumtrading@ofcom.org.uk**
Fax: +44(0) 20 7981 3333 (marked 'Spectrum Trading Consultation')

3.1.6 In addition, a telephone desk is available to answer any questions and to take spoken responses. Please call Ofcom on 020 7981 3000 and ask for the spectrum trading consultation desk.

3.1.7 If you are a representative body, please summarise the persons or organisations represented. Electronic versions of responses would be appreciated. Any confidential parts of a response should be placed in a separate annex, so that non-confidential parts may be published along with the respondent's identity. If the whole of a response is confidential, including the identity of the respondent, this should be clearly stated. Copyright in responses will be assumed to be relinquished unless specifically retained.

3.1.8 This consultation is the responsibility of Graham Louth, Head of Spectrum Markets at Ofcom.

3.1.9 Any comments or complaints about the conduct of this consultation should be addressed to:

Philip Rutnam
Partner, Competition and Strategic Resources
Ofcom
Riverside House
2a Southwark Bridge Road
London SE1 9HA
email: **philip.rutnam@ofcom.org.uk**
Fax: +44(0)20 7981 3333
Telephone: +44(0) 20 7981 3000

3.1.10 Responses will be published on Ofcom's website www.ofcom.org.uk, along with a summary, except where respondents have specifically requested confidentiality.

3.1.11 Specific numbered questions on which responses are sought are incorporated in the text of this consultation document and are listed in Annex A. Ofcom would also be interested to receive comments on any other aspects of spectrum trading.

3.2 Ofcom's consultation standards

3.2.1 All Ofcom's consultations will adhere to its seven consultation principles. These will be published in every written consultation document that Ofcom issues. When it conducts a written consultation, Ofcom will:

- hold discussions with stakeholders before issuing a major consultation document – to find out whether we are thinking in the right direction. If this is not possible, an open meeting to explain the proposals will be held soon after publication.
- be clear about who is being consulted, why, on what questions and for how long.
- make the document as simple and concise as possible – with a summary of no more than two pages – and make it easy to respond to. This may involve issuing a shorter version aimed at hard-to-reach groups, like SMEs.
- Allow ten weeks for responses, other than on dispute resolution.
- Monitor and evaluate consultations, and designate a consultation champion – an evangelist within Ofcom for better consultation and reach out, and a contact point for comments on our process. Ofcom's first consultation champion is Philip Rutnam. He can be contacted at **philip.rutnam@ofcom.org.uk** and on +44(0) 20 7981 3000.
- Explain why Ofcom is departing from any of these tests if it has to – for example, because of urgency or confidentiality. If a shorter period is required, Ofcom will draw this to the attention of stakeholders, as a red flag item.
- Analyse responses with care and an open mind. We will give reasons for subsequent decisions, and an account of how the views expressed during consultation helped to shape those decisions.

3.2.2 Because of the complexity of these proposals, the Executive Summary to this document exceeds two pages. Ofcom has also published a shorter document, *Ofcom Consultation on Spectrum Trading – A Summary*, designed to explain its proposals to companies and individuals who do not have the time or expertise to respond to this full consultation paper.

3.2.3 Ofcom has allowed 12 weeks for responses for this consultation, in recognition of the disruption caused by the Christmas period.

Section 4

Background

4.1 Need for spectrum trading and purpose of this consultation document

4.1.1 One of Ofcom's duties under the Communications Act 2003 is to ensure the optimal use of the radio spectrum in order to further the interests of citizens and consumers. Managing spectrum in a way that optimised its use was a more straightforward task for wireless telegraphy when there was enough spectrum available to accommodate most (if not all) potential users. In this context, spectrum management involved issuing licences to use spectrum on an essentially first-come, first-served basis without having to make decisions about which users were most deserving of spectrum.

4.1.2 But the task of managing spectrum has become much more difficult in recent decades as the demand for spectrum has grown for existing uses, and entirely new uses of spectrum have developed. This has meant that there is not enough spectrum for all those wishing to use it. As the RA has highlighted in its most recent strategy report1: "The proliferation of services and uses is such that there is now no part of the spectrum which is unallocated at the international level below 275 GHz and, in the UK, the spectrum is fully occupied, or at least committed, up to around 60 GHz".

4.1.3 As the demand for spectrum has grown, spectrum management has increasingly involved finding ways of allocating spectrum between competing uses and users. To do this properly requires information about the value of spectrum to different users – yet such information is sometimes difficult to obtain.

4.1.4 By allowing licensees the ability to transfer or deal with their rights of use, spectrum trading encourages each licensee to consider whether they should retain their rights, or sell them. Trades can be expected to take place when the spectrum is worth more to another user than it is to the existing user, thereby improving spectrum efficiency over time.

4.1.5 Spectrum trading is not an end in itself. A well-designed trading system could yield substantial benefits, while a poorly-designed trading system could impede the effective management of the spectrum without yielding such benefits. The purpose of this consultation is to gain the input of a wide range of interested parties – including current and potential users of spectrum, businesses and consumers – into the design of the trading system so that the benefits can be realised and the risks avoided or mitigated. Where necessary, Ofcom is also seeking views on certain related proposals, such as interference and dispute resolution procedures. As set out in Section 4.7 below, Ofcom expects to consult further on a number of these areas in due course.

4.2 Benefits of trading

4.2.1 Trading should allow the right to use a particular block of spectrum to be transferred to, and used by, the user who values it most. Over time, this should ensure that more spectrum is employed in the use, and by the user, that brings the greatest benefit to the economy.

4.2.2 An optimal allocation of radio spectrum through the market brings a number of benefits. Efficient companies using radio frequency will be able to expand and displace less efficient companies. Services which are popular and for which there is strong demand will be able to access more spectrum, and so increase their capacity and/or keep their costs down. The introduction of a system of trading provides an opportunity to minimise the transaction costs of acquiring

1. *Strategy for the Future Use of the Radio Spectrum in the UK (2002)*, Radiocommunications Agency, April 2002, available at http://www.radio.gov.uk/topics/spectrum-strat/future/strat02/

spectrum. Finally, spectrum trading creates a mechanism for entrepreneurs who wish to use spectrum for innovative and high-value new services to acquire spectrum from outdated, declining or low-value technologies.

4.2.3 Ofcom believes that the introduction of spectrum trading, and the greater flexibility to change the use and configuration of licences, will be strongly beneficial to consumers. However, consumers may experience both positive and negative impacts. On the positive side, consumers are expected to benefit from:

- Cheaper prices for the most profitable and popular wireless services. Providers of these services may be able to provide extra capacity more cheaply by acquiring rights to use or access additional spectrum.
- Greater choice. Alternative suppliers of popular services may be able to enter the market by acquiring rights to use spectrum previously used for other purposes.
- Faster access to innovation. Spectrum trading will provide entrepreneurs with a greater opportunity to acquire rights to use spectrum to offer innovative new services.

4.2.4 On the other hand, spectrum trading may have some less welcome side-effects. In particular, consumers may find that suppliers of less popular services may be more readily inclined to cease supplying them. Spectrum trading will increase the opportunity costs of using spectrum to suppliers of less profitable services, because it will offer them the opportunity of selling their spectrum for alternative uses which may be valued much more highly. Therefore, consumers – who in many cases will have invested in expensive radio equipment – may find that their equipment is no longer supported by the supplier of a commercial service.

4.2.5 Ofcom believes that its proposals for spectrum trading will also benefit large users of spectrum, small users, and entrepreneurs.

- Large users of spectrum (for example telecoms companies) will benefit from a greater certainty over the term of their rights to use spectrum, the opportunity to improve returns from under-used spectrum resources, and the potential to access more spectrum for expanding technologies.
- Small users of spectrum (for example private business radio users) will benefit from the opportunity profitably to invest in new equipment and sell any spectrum that is released as a result, or to purchase more spectrum if they require it due to the expansion of their business.
- Entrepreneurs will be free to compete for spectrum for new technologies or services on equal terms with incumbents. Spectrum trading and opportunities to change the use of spectrum will also remove barriers to entry to markets where lack of access to spectrum previously restricted entry by new players.

4.2.6 Ofcom is obliged to consider a number of statutory duties in considering the appropriate design of a spectrum trading regime. Ofcom's principal duties are to further the interests of citizens in relation to communications matters, and to further the interests of consumers in relevant markets, where appropriate by promoting competition. Some of the particular considerations that Ofcom has taken into account when drawing up the proposals contained in this consultation document are:

- *the optimal use of the electro-magnetic spectrum for wireless telegraphy.* As explained above, Ofcom believes that a trading system can in principle create a more efficient allocation of spectrum than an assignment-based system. However, Ofcom has been careful to retain safeguards to

ensure access to spectrum for public services, and mechanisms to counter undue interference.

- *the availability of a wide range of electronic communications services, and the encouragement of investment and innovation.* Ofcom believes that a trading system furthers this objective by providing prospective providers of innovative services with the opportunity to compete for access to spectrum on equal terms with incumbent providers. For certain incumbent services, Ofcom will continue to require adherence to obligations such as public service broadcasting commitments, or network roll-out obligations, in order to protect the availability of services to consumers.
- *the promotion of competition in relevant markets.* Ofcom is proposing a system of scrutinising spectrum trades to ensure that spectrum trading does not cause distortions of competition in markets for spectrum, or the markets in which spectrum is an input.
- *the different needs and interests of all persons who may wish to make use of the electromagnetic spectrum.* Ofcom's proposed spectrum trading system is designed to protect very small users of spectrum, such as maritime radio users and CB radio users. Ofcom has also considered the needs of radio users who use the spectrum for purposes such as astronomy and scientific research. The proposed system is designed to allow smaller licensees, such as private business radio users, to benefit from trading as well as very large and well funded licensees.
- *the need for transparent, accountable, proportionate and consistent regulation, targeted only where action is needed.* In general, Ofcom has attempted to minimise regulation in its design of a spectrum trading system. However, it is essential that high quality interference management is maintained and that distortions of competition as a result of spectrum trading are avoided. The regulations that Ofcom is proposing are designed to address specific problems such as these. Ofcom has endeavoured to design its proposed trading system in a way that maximises transparency and accountability.

4.2.7 The introduction of spectrum trading involves a number of risks. Ofcom has designed its proposals to mitigate these risks as far as possible. A full discussion of potential risks is provided in Annex B, and they include:

- *Lack of trading activity.* Ofcom has sought to maximise the breadth and depth of trading activity by proposing to introduce trading as simply and as quickly as possible, subject to the need to maintain responsible management of the radio spectrum.
- *Risk to safety of life services.* Ofcom proposes to continue the RA's practice of regarding the safety of life services to be of paramount importance in interference disputes. In addition, though some public sector users may be able to trade spectrum, access to the existing assignments for these services will be protected.
- *Interference.* Ofcom will not permit the introduction of trading to result in an interference free-for-all. The volume of interference disputes may increase, partly due to reasons unconnected with trading, and partly as a result of the reconfiguration and change of use of licences that Ofcom is proposing to permit. However, where a licensee wishes to change the use or configuration of its licence, Ofcom will need to approve such a change, and protection of other users will be a key criterion it will consider. Ofcom is also proposing a dispute resolution procedure to deal with interference disputes quickly and efficiently.

Question 1:

(a) Do you believe that spectrum trading will be beneficial to consumers, businesses and radio users?

(b) What could Ofcom do to increase the benefits and mitigate the disadvantages of spectrum trading?

4.3 Consistency with broader spectrum management strategy

4.3.1 Spectrum trading is just one of a number of mechanisms that Ofcom will use to manage the radio spectrum. Trading will complement a number of other spectrum management processes which will continue to be used. These include the following:

- *Exemption from licence obligations.* Where Ofcom is satisfied that particular radio equipment is not likely to involve any undue interference with wireless telegraphy, Ofcom will be required to exempt the use of that radio equipment from the general obligation to obtain a WT Act licence. As part of this process, the RA is currently considering the possibility of deregulation in certain licence classes. For example, it may be possible in future to exempt on-board maritime spectrum use from individual licensing. In future, as technologies such as software-defined radio advance and become more widespread, Ofcom may make much greater use of licence exemption as a spectrum management tool, rather than issuing tradable licences.
- *Primary assignments of spectrum.* Ofcom will continue to assign previously unassigned spectrum, or spectrum that has been cleared of previous users, where this is necessary to protect against undue interference. Ofcom intends to continue to use market-based methods to make these kinds of primary assignments for large assignments in an objective, transparent, non-discriminatory and proportionate manner. These may be complex auctions for large assignments, or single round auctions for small blocks of spectrum, such as new spectrum for private business radio systems.
- *Administrative incentive pricing.* Annual fees designed to encourage users to make efficient use of spectrum have applied to certain licence classes for some time. The RA has recently commissioned a review of spectrum pricing, which is being undertaken by the consulting firms Indepen and Aegis, and Warwick Business School. Further details on the role of administrative incentive pricing are set out in Section 8.6.
- *International harmonisation and interference agreements.* The international harmonisation of spectrum use may take place as a result of certain binding EU measures or as a result of other international agreements and arrangements to which the UK is a party. Under these arrangements, the UK commits to assign particular allocations of spectrum for particular purposes. The RA also manages interference on certain frequencies with neighbouring countries. Ofcom will continue to use these international co-ordination tools, and spectrum trading will be designed to work within the constraints that current and future international arrangements impose. Further details on the role of international harmonisation are set out in Section 8.2.
- *Administrative spectrum management.* Certain spectrum classes will either require some delay before trading can be introduced, or may never be suitable for trading. For example, on-board maritime and aviation licences will not be tradable. In these licence classes, assignment based spectrum management processes will continue to be used. In addition, under the Communications Act, the Secretary of State will have certain powers to direct Ofcom that certain frequencies are kept available or made available for specific purposes.

4.3.2 Spectrum trading alone may be insufficient to address all spectrum management requirements. For example, a successful UK Olympic bid would

require certainty up to ten years in advance over availability of large amounts of spectrum for programme-making, organisation and safety. A trading market may not be able to deliver certainty for such instances of extraordinary demand, because current owners of spectrum may be insufficiently certain of their future plans to be able to trade this right. In such circumstances, other approaches to spectrum management may be necessary.

4.3.3 Ofcom has a large number of statutory duties, including a principal duty to further the interests of citizens and consumers in the UK by (among other things) securing the optimal use of spectrum for wireless telegraphy. At present, Ofcom is planning to use spectrum trading as one element of its spectrum management policy, in order to comply with its statutory duties. However, Ofcom cannot fetter its ability to change its policy as it considers appropriate in the light of future developments. For example, it is possible that the UK Government and Ofcom could, at some stage in the future, decide that an alternative assignment system was in the best interest of UK consumers and citizens. The implementation of such a system may require Ofcom to exercise its statutory powers under the WT Acts (or any new legislation) to terminate existing WT Act licences. However, Ofcom would consult widely before making any such policy decision.

4.4 Spectrum trading and advances in technology

4.4.1 Technology is starting to provide mechanisms to help deal with spectrum scarcity.

4.4.2 Modern transmission equipment is increasingly frequency-agile; i.e. it can transmit on any one of many frequencies. Ofcom believes that spectrum trading complements this trend, as it provides a mechanism for owners of such equipment to secure alternative frequencies on which they may transmit.

4.4.3 However, other emerging technologies do not lend themselves to a system which provides for exclusive rights to use certain spectrum. Software-defined radios are able to distinguish one transmission from many others transmitted on the same frequency, and therefore lend themselves to spectrum 'commons'. Ultra wideband technology spreads a transmission thinly over a very wide range of frequencies.

4.4.4 Ofcom recognises that its overall approach to spectrum management in future will need to realise the benefits of these new technologies that do not lend themselves to a system based on exclusive rights to use spectrum. This may mean that in future it will designate a greater proportion of spectrum as licence exempt.

Question 2:
How could Ofcom's proposals for spectrum trading be amended to reflect the potential benefits of emerging transmission technologies?

4.5 Statutory framework

4.5.1 Following recognition that a centrally-based administrative system of spectrum management would be unlikely to produce the best allocation of spectrum, the spectrum management regime was reformed in the Wireless Telegraphy Act 1998. It introduced market mechanisms, such as administrative incentive pricing of spectrum and competitive auctions of spectrum, in an attempt to encourage efficient use.

4.5.2 Spectrum trading has for some time been seen as a desirable and logical development of those reforms. The December 2000 White Paper: *'A New Future for Communications'* reaffirmed the UK Government's commitment to spectrum trading.

The EU Framework Directive (Directive 2002/21/EC), which is now implemented in UK law under the Communications Act 2003, enables Member States to introduce trading. It permits a wide range of approaches, subject to the need to ensure that competition is not distorted as a result of any trade and that the use of spectrum harmonised under Community measures does not change.

4.5.3 The Communications Act 2003, which will come fully into force in December 2003, contains provisions allowing Ofcom to establish a spectrum trading regime. Ofcom is given power to make regulations authorising the holder of a WT Act licence or the holder of a grant of Recognised Spectrum Access (RSA) to transfer the rights and obligations under its licence or grant of RSA to another person. This will enable the development of a market in rights arising under licences and grants of RSA.

4.5.4 Under these regulations, Ofcom may (among other things):

- authorise partial, as well as outright, transfers of rights and obligations;
- restrict the circumstances in which, the extent to which, and the manner in which a transfer may be made;
- require the approval or consent of Ofcom for the making of a transfer;
- provide for a transfer to be effected by the surrender of a licence or grant of RSA and the grant of a new one in respect of the transfer;
- give itself the power to direct that a transfer must not be made, or may only be made after compliance with certain conditions imposed by Ofcom;
- require payments to be made in respect of the approval or consent process and/or make provision for the giving of security in relation to such payments;
- impose requirements as to the procedure to be followed for making a transfer and, in particular, about the notice which must be given to Ofcom or must be published either before or after the transfer;
- impose certain requirements to keep and publish records of the transfer; and
- set out the factors which Ofcom must take into account when making any necessary determinations under the regulations.

4.5.5 Under the Communications Act, new transfers which fail to comply with the Ofcom regulations will generally be void.

4.5.6 In addition to its powers to introduce a spectrum trading mechanism, Ofcom will also have a range of general statutory powers and duties with regard to spectrum management and licensing. These include (among others):

- powers to grant, vary, revoke and enforce WT Act licences;
- powers to make regulations regarding grants of Recognised Spectrum Access and, in future, to make such grants;
- powers to exempt certain radio equipment from the general requirement to hold a WT Act licence;
- certain duties in relation to spectrum management, including a duty to publish a Plan for UK Frequency Authorisation and a power to establish a register of licence information;
- duties to provide advisory and dispute resolution services with respect to interference issues;
- power to make and enforce regulations on the requirements to be met by users, manufacturers and importers of radio apparatus and of equipment which could cause radio interference; and
- power to make and enforce regulations restricting the manufacture, sale, import and use of specified radio apparatus.

4.6 Results of previous consultations

4.6.1 In 1998, the Radiocommunications Agency held a consultation entitled 'Managing Spectrum through the Market' which discussed the introduction of spectrum trading. It set out a broad range of options for the introduction of spectrum trading, and discussed a number of complexities involved.

4.6.2 *The Review of Radio Spectrum Management* by Professor Martin Cave (the 'Cave Review') published in March 2002, strongly supported spectrum trading. The Government Response to the Cave Review, published in October 2002, largely concurred with Professor Cave's findings.

4.6.3 In July 2002 the Radiocommunications Agency published a consultation document *'Implementing Spectrum Trading'* and received about 40 responses. Most were broadly supportive of the introduction of trading but had some concerns about detail. This consultation paper has been written following careful consideration of the results of that consultation study and subsequent discussions with stakeholders, including a workshop on spectrum trading hosted by Ofcom in September 2003.

4.6.4 Several studies are underway to follow the Government's response to the Cave Review. These include a study of Administrative Incentive Pricing (AIP) of spectrum. This is reviewing the previous methodology devised by Smith NERA in 1996 (and revised in 1998) and will recommend a new methodology for future calculation of AIP levels. Another ongoing study is considering the benefit of harmonisation of spectrum management internationally, including the extent to which the UK should adopt international harmonisation decisions. As conclusions develop from these studies, Ofcom will consider how, and the extent to which, they should be taken into account in the development of spectrum trading.

4.6.5 Ofcom and the RA have developed the proposals in this consultation document working closely with the relevant regulators and Government departments with an interest in the radio spectrum, including:

- Independent Television Commission;
- the Radio Authority;
- Department for Trade and Industry;
- Ministry of Defence;
- HM Treasury;
- Department for Culture, Media and Sport;
- Financial Services Authority;
- Office of Fair Trading; and
- Civil Aviation Authority.

4.7 Further consultation and next steps

4.7.1 Ofcom is intending to introduce spectrum trading in some licence classes by the end of 2004. After considering the responses to this consultation document, Ofcom will issue a statement setting out its conclusions. Ofcom expects to follow up particular issues individually with certain respondents.

4.7.2 Ofcom will then develop more detailed proposals in a number of the areas addressed by this consultation document. In the first half of 2004, Ofcom expects to consult further on a number of these areas in detail. For example, these are likely to include consultation:

- with licence holders in particular licence classes on proposed licence amendments;
- on detailed mechanisms for preventing distortion of competition;
- on interference management and dispute resolution procedures;
- on the statutory instruments which are necessary to implement trading; and

- on other areas which are covered in outline in this consultation paper.

4.7.3 These consultations will be scheduled to allow detailed policies to be agreed and implemented in time for trading to start in the selected licence classes by the end of 2004.

4.7.4 In parallel, Ofcom expects to consult on the spectrum pricing proposals arising from the Review of Spectrum Pricing which is currently underway.

4.7.5 Setting up the processes, and implementing the changes to the licensing regime necessary for spectrum trading, will be a very complex task for Ofcom. As discussed in Annex B, Ofcom's initial estimates are that the set up costs of spectrum trading will be around £2.9 m (not including the costs of projects, such as verifying licence records, which would be necessary with or without trading). Ofcom will be carrying out detailed implementation planning for spectrum trading in early 2004, and expects to use the results of this consultation as an important input into this implementation plan.

Section 5

Introduction of Trading

5.1 What this section covers

5.1.1 This Section describes Ofcom's proposed overall approach to spectrum trading, and introduces some of the complexities involved. Sections 6, 7 and 8 provide more detail on Ofcom's proposals, and Section 9 describes their proposed application to individual licence classes.

5.1.2 Ofcom is proposing two distinct policies. First, it is proposing to allow trading (i.e. transfer of ownership) of WT Act licences. Second, it is proposing to liberalise the use of spectrum by permitting licensees to change the use of, or reconfigure, their licences in certain circumstances.

5.2 Approach to trading

5.2.1 Ofcom's overall approach is to realise the benefits of spectrum trading by a steady and progressive introduction of trading over a four-year period. Our approach will be pragmatic, recognising a balance between competing interests. Our intention is to promote both tradability (the sale or transfer of rights to others), and liberalisation (flexibility over configuration and use of licences). We will monitor the effectiveness of spectrum trading as it is rolled-out, to ensure that lessons learnt from licence classes that are traded initially are taken into account as spectrum trading is extended to subsequent licence classes.

5.2.2 In introducing a new trading regime, Ofcom will seek to clarify the rights of existing holders of WT Act licences, and will provide clear and flexible rules for the transfer of such rights to others. Where it is introduced, Ofcom proposes that tradability would apply to every licensee in the licence class, rather than as an option for licence holders. However, while the new regime will give WT Act licensees the flexibility to trade, no licensee will be obliged in any way to do so.

5.2.3 Alongside the introduction of tradability, Ofcom proposes to liberalise the use of spectrum by encouraging licensees to apply to change the configuration or use of their licences should they wish. Ofcom has the power to amend a WT Act licence at the request of the licence holder. In order to provide an appropriate degree of flexibility and certainty to licensees, Ofcom is proposing to issue guidance setting out the criteria which it will use to decide whether or not to make such licence amendments when requested by licensees. In setting these criteria, Ofcom will need to take account of various factors including existing harmonisation arrangements, domestic policy constraints, and the need to avoid undue interference to other licensees.

Question 3:

(a) Should tradability be universal within licence classes, and not an option, as proposed?

(b) Do you agree that liberalisation of spectrum use should be implemented through issuing guidance rather than through the precise definition of licence terms?

5.3 Introduction of Spectrum Trading

Clarifying the rules for transfers of rights and obligation

5.3.1 Although WT Act licences are expressed not to be transferable, there are already certain ways in which rights to use spectrum may currently be transferred. These include a change of control of a licence holder, the revocation and reissue of a licence by the Secretary of State, or where the licensee authorises another in writing to operate radio equipment. These existing mechanisms are, however, unnecessarily cumbersome and uncertain. In accordance with its powers under the Communications Act, Ofcom will seek to introduce rules which provide clear and certain authority for the transfer of rights and obligations

arising under WT Act licences and, possibly in future, grants of RSA.

5.3.2 Ofcom does not consider that existing licences must necessarily be amended to allow for the introduction of spectrum trading. As set out in more detail in Section 7.5, Ofcom envisages that spectrum trading will generally involve the transfer of rights to use spectrum, rather than the transfer of the licence itself. Once a licensee has agreed to transfer its rights (and certain related obligations) to a third party, the parties to the trade will notify Ofcom. In most circumstances, the existing licensee will be required to surrender its licence to Ofcom. Ofcom will generally then cancel the existing WT Act licence and reissue the appropriate new licence or licences. The right to transfer rights and obligations under WT Act licences will, therefore, generally be granted by means of regulations adopted by Ofcom, rather than amendments to WT Act licences. There are a number of advantages of this path:

- It will enable trading to be introduced more quickly than if Ofcom were to have to amend each individual WT Act licence; and
- It minimises transaction costs to licensees and to Ofcom.

5.3.3 The Communications Act specifically grants Ofcom the power to introduce spectrum trading by means of the surrender of the existing licence and the grant of a new one. Ofcom considers that it is not necessary or appropriate to reassign existing licences prior to the introduction of spectrum trading. This approach therefore does not require any administrative judgement of whether spectrum is currently appropriately utilised, and leaves such decisions to the market to make by means of trading. Ofcom considers this approach to be consistent with its statutory duties and a Ministerial commitment given during passage of the Wireless Telegraphy Act 1998[2], that existing users would not be required to take part in a competitive process for the right to continue to provide their current services within their existing spectrum assignment, irrespective of how they originally acquired their licences.

5.3.4 Under these proposals, the procedure for trading rights to use spectrum will be set out in separate regulations. However, the licence itself will become a clear statement of the holder's (tradable) rights to use a portion of spectrum (as described in Section 6 below). The proposed process for issuing new licence documentation for the new owner is described in Section 7.5.

Question 4:
Are there any reasons why existing licence holders should not be authorised to participate in the trading process? If so, please provide details of which types of licence holders you consider should be excluded from the new trading process and why.

Leasing and hiring rights to use spectrum

5.3.5 It is proposed that as well as being able to sell rights to use spectrum outright, licensees should where possible be permitted to transfer all or some of their rights and obligations to other users for a specified period of time (a spectrum 'lease'), or on a temporary basis (a spectrum 'hire').

5.3.6 In the case of spectrum leases, at the end of the specified period, the specified rights and/or obligations would revert back to the original licence holder. Ofcom would update its register of licensing information to reflect the temporary transfer and would issue the lessee a licence.

5.3.7 Spectrum hires would typically be for a very short period (for example, overnight or for a few weeks), and Ofcom would not need to issue a new licence.

2. "First, I wish to stress that we do not propose to require existing licensees to enter an auction for the right to continue to provide their current services within their existing spectrum allocation" House of Lords Hansard, 5 June 1997 column 720.

Though Ofcom would be required to be notified of such hires, it would not need to give its approval.

5.3.8 In a market-oriented regime, such as that being proposed, it is important that the users recognise their responsibilities as well as their rights and opportunities. It is necessary for there to be clarity about who has the responsibility for licence obligations so that Ofcom will know whom to contact in the case of breach of licence conditions or if there is an interference problem. Ofcom believes that responsibility for compliance with obligations contained within WT Act licences should generally remain with the operator of transmission equipment (whether primary licence holder, lessee or hirer).

5.3.9 The detailed processes and licensing arrangements for leasing and hiring of rights are discussed in more detail in Section 7.5.

Recognised Spectrum Access (RSA)

5.3.10 The Communications Act makes provision for Ofcom to make grants of Recognised Spectrum Access (RSA). RSA is a new spectrum management tool which is complementary to licensing. The WT Acts require the installation or use of radio equipment in the UK to be licensed unless it has been exempted from licensing. Grants of RSA, on the other hand, may be made where a WT Act licence is not required. For example, RSA could be available in selected frequency bands for satellite transmissions that were intended for reception in the UK (although it might also be available in other circumstances). It would not, however, be compulsory to have RSA in order to transmit signals for reception in the UK.

5.3.11 The grant of RSA would confer on the holder the benefit that Ofcom, in carrying out its spectrum management functions, would be required to take into account the terms of an RSA to the same extent as it would take into account a licence. Under the Communications Act, a grant of RSA would set out the extent to which the holder's use of the spectrum is recognised, and any relevant restrictions and conditions (for example, as to the strength or type of the signal, times of use and sharing of frequencies).

5.3.12 The introduction of RSA will require further regulations to be adopted by Ofcom. There will be further consultation, for example on which services should be made eligible for RSA, before this is done. Ofcom will address the extension of tradability to RSA as part of this consultation.

Question 5:
Should RSA be tradable?

5.4 Liberalising the use of spectrum

5.4.1 Simultaneously with the introduction of trading, Ofcom is proposing to liberalise the use of spectrum, by providing a mechanism for licensees to reconfigure or to change the use of their licences. This may or may not be in the context of a trade.

5.4.2 Reconfiguration and change of use are defined as follows.

5.4.3 *Reconfiguration* is the re-definition of the frequency bands in relation to which the licensee has rights, or the geographical area in which the licensee may exercise such rights. For example it includes separating one licence into two, or amalgamating two licences which are adjacent in terms of frequency or geography. It also includes changing transmission characteristics within a licence, for example, by moving a transmitter.

5.4.4 *Change of use* of licences may be contemplated to different degrees, as follows.

- *Change of licensee's line of business* – the licensee may wish, for example, to use a Private Business Radio licence held by a taxi company for a courier business instead. However, no change may be contemplated to the precise technology used, or the radio service (e.g. mobile radio).
- *Change of technology* – the licensee may wish to use, for example, a new radio technology with a different modulation to provide the same radio service (e.g. mobile radio).
- *Change of application* – the licensee may wish to amend its licence to allow, for example, a fixed wireless service to use the spectrum in place of a mobile service.

5.4.5 Liberalising the use of spectrum in these ways is essential to realising many of the benefits of spectrum trading. By permitting requests for reconfiguration and changes of use where appropriate, Ofcom will allow licence holders to seek higher value economic uses from their spectrum, within the transmission rights contained in their licences. Currently, innovation is restricted to those services and technologies determined by the regulator at the time the licence is granted.

5.4.6 Ofcom is proposing to liberalise the use of spectrum in this way through a two stage process. First, for each licence class where trading has been introduced, Ofcom will issue clear guidance on the circumstances in which it would in principle permit requests for change of use or reconfiguration by licensees, and the criteria it would expect to use in assessing such requests. Second, it will consider requests by licensees to make such changes on a case-by-case basis. The Wireless Telegraphy Act sets out a procedure under which Ofcom may vary existing licence conditions, including at the request of the licensee. In considering such requests, Ofcom will seek to apply its stated criteria in accordance with its statutory duties, and in a manner which encourages flexibility in terms of permissible changes, unless there are objectively justified reasons to do otherwise.

5.4.7 The considerations which Ofcom will take into account in issuing this guidance, and in assessing proposed changes of use or configuration, are discussed in detail in Section 8.2, and include:

- international harmonisation arrangements and interference agreements.
- domestic policy constraints: in some licence classes, other policy objectives (such as digital switchover in broadcasting) could be hindered by early or extensive liberalisation of spectrum use.
- constraints arising from the nature of the spectrum in question. These include co-ordination and interference constraints, and the sharing of spectrum bands.

5.5 Phasing of introduction

5.5.1 Ofcom intends to set the timetable for the introduction of spectrum trading in a transparent and proportionate manner, taking into account the circumstances of different licences and licence classes. Ofcom is proposing that, at the same time as trading is introduced for a licence class, Ofcom will issue guidance on the circumstances in which it would expect to permit requests for reconfiguration or change of use of such licences.

5.5.2 The appropriate speed of introduction of spectrum trading and liberalisation is a trade-off between competing considerations. On the one hand, early introduction allows the benefits of trading to be realised sooner, and will provide a large quantity of spectrum within which trading can become established. On the other hand, a

slower introduction will allow time for lessons learnt in licence classes where trading is introduced at an early stage to be reflected in the licence classes where it is introduced later.

5.5.3 Ofcom is proposing to introduce tradability and liberalisation to different extents and at different times for the various WT Act licence classes. These proposals are based on a common set of principles. These are:

- Trading and liberalisation should be introduced early in licence classes where the benefit is greatest. This may be because there is substantial excess demand for spectrum (either in its current use or for alternative uses), or because there is evidence that spectrum is being under-used;
- Trading and liberalisation may be delayed where there is uncertainty about the future availability of spectrum, or where other spectrum management or public policy issues makes spectrum trading particularly complex (for example, owing to digital switchover in TV broadcasting).

5.5.4 Ofcom's detailed proposals for introduction of trading and liberalisation are described in Section 9 for each individual licence class. A summary of Ofcom's proposed timetable for the next four years is provided in Exhibit 1 below. Ofcom expects to review the timetable for introduction of trading in the later licence classes in the light of the lessons learnt from the earlier licence classes.

5.5.5 The Communications Act does not envisage that the new trading regime will extend to licence exempt spectrum. Licence exempt spectrum is not suitable for trading because licence exemption confers no individual rights on users. Ofcom does not therefore propose to extend trading to licence exempt spectrum.

5.5.6 It is proposed that the Ministry of Defence (MoD) should be allowed to trade its spectrum and benefit from the proceeds. Ofcom expects this arrangement to begin at the end of 2004. As a crown user, the MoD does not hold WT Act licences for its spectrum. Therefore, the most appropriate process for release of spectrum may be for the MoD to release this spectrum to Ofcom, who would then define licence terms and introduce the spectrum to the market as a primary assignment on behalf of the MoD.

5.5.7 Ofcom has measured the proportion of spectrum it is proposing to make tradable over time, in terms of the net economic benefit to the UK economy of the different sectors of the radio spectrum[3]. Ofcom calculates that by 2007, over 80 per cent of the spectrum by value will be tradable, with 19 per cent tradable by the end of 2004. This is shown in Exhibit 2.

3. Calculation based upon 'Economic Impact of Radio, 2002 Update', Radiocommunications Agency, April 2002. This values spectrum on the basis of the sum of consumer and producer surplus by licence class. Commercial aviation, Ministry of Defence and some licence exempt spectrum is excluded from the RA's analysis.

Exhibit 1: Phasing of the introduction of trading

Year	Licence class	Comment
2004	Analogue PAMR	• Subject to the conclusions of the consultation currently underway on the future use of L-band and Band III spectrum (which includes bands currently used for PAMR)
	National paging	• Spectrum possibly under-utilised – change of use and configuration will be permitted
	Data networks	• Change of use and reconfiguration within the constraints of UK adoption of future possible harmonisation for asset tracking
	Fixed wireless access	• Reconfiguration and change of use permissible within fixed services
	National and regional PBR	• Exclusive geographically defined channels – change of use within land mobile[4] will be permitted
	Common Base Stations	• As national and regional PBR above
	On-site PBR	• As national and regional PBR above
	5.8GHz Band C	• Change of ownership only will be permitted from the end of 2004
	32GHz	• Currently vacant, tradability and flexibility in use will be permissible from the date of issue
	Scanning telemery	• National channels used by utilities • Reconfiguration and change of use will be permissible
	Fixed terrestrial links	• Tradability and reconfiguration permissible – but not change of use owing to interference to neighbouring links
	Sound broadcasting	• Transfer of ownership of analogue sound broadcasting WT Act licences will be permissible • In addition, limited aggregation and partition of digital sound broadcasting WT Act licences will be permissible, to allow some trading of interference rights subject to fulfilment of Broadcasting Act obligations

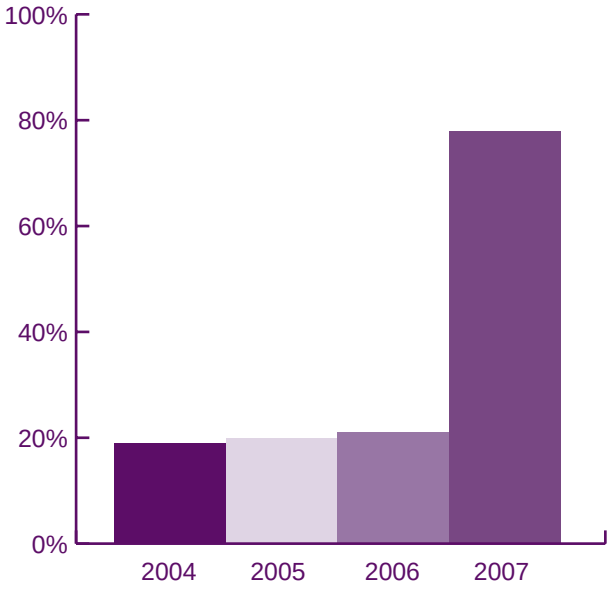
4. Terrestrial mobile services with point-to-area transmission characteristics, examples include private business radio systems, common base stations, trunked radio (PAMR) and cellular mobile radio services, such as GSM or WCDMA

Exhibit 1 (contd.): Phasing of the introduction of trading

Year	Licence class	Comment
2005	Wide area PBR	• Assignments in this category are shared, so trading will require recourse to MASTS[5] (due to be completed in 2005) to monitor changing nature of use
	Digital PAMR	• Delayed until the completion of reassignment exercise in conjunction with the MoD
	Programme-making and special events	• Introduction of SMO-style programme-making licences some time in 2005 or later
2006	Emergency services	• Delayed until questions regarding the future organisation and assignment of spectrum for the emergency services have been resolved
2007	Television broadcasting (analogue and digital)	• Tradability in television broadcasting delayed until frequency plan for digital switchover, including international co-ordination considerations, is clear – anticipated by end 2007
	2G and 3G mobile spectrum	• Delayed subject to there being sufficient clarity over plans for the re-farming of 2G spectrum and release of 3G expansion spectrum
	Aviation and maritime communications	• Agreement by 2007 on tradability for ground-based aviation and maritime coastal communications rights of use. Changes of use will be permitted within the constraints of international harmonisation and agreements, safety of life considerations, and with the agreement of sector regulators CAA and MCA
	Radionavigation (radar)	• Agreement on tradability of radio navigation rights of use between 2007 and 2009 • Tradability and changes of use permitted within the constraints of international harmonisation and agreement of sector regulators
Other	Mobile satellite	• Tradability subject to introduction of Recognised Spectrum Access
	Satellite shared with terrestrial services	• Tradability subject to introduction of Recognised Spectrum Access

5. Mobile Assignment Tool (MASTS) – the RA's electronic assignment system used for private business radio systems

Exhibit 2: Proportion of spectrum tradable over time, in terms of net economic benefit of different licence classes to the UK economy[5]



Question 6:

Do you think trading should be introduced more or less rapidly than suggested above?

5. Calculation based upon "Economic Impact of Radio, 2002 Update", Radiocommunications Agency, April 2002. This values spectrum on the basis of the sum of consumer and producer surplus by licence class. Commercial aviation, Ministry of Defence and some licence exempt spectrum is excluded from the RA's analysis.

Section 6

Creation of Tradable Rights

6.1 What this section covers

6.1.1 Most WT Act licences are currently defined in a way that does not easily facilitate spectrum trading. In order for trading and liberalisation of spectrum use to take place, it will be desirable to change certain licence conditions for some classes of licence and to issue particular policy guidance, in order to define more clearly the right of use that licensees have.

6.1.2 This section describes how the rights and obligations imposed by WT Act licences are currently defined, how they ideally would need to be amended in order to establish a tradable right, and the issues that will arise as Ofcom changes licence conditions and issues policy guidelines. Section 9 describes the changes to licence conditions which Ofcom is proposing for each individual class of spectrum licence.

6.2 Current licensing approach

6.2.1 This section describes the manner in the rights and obligations under most WT Act licences are currently defined.

Definition of right of use

6.2.2 Under the WT Acts, it is a criminal offence to install or use stations or apparatus to transmit or receive certain messages or information using the radio spectrum without a licence. In the context of this legal framework, the RA has adopted three broad approaches to defining rights of use. These are[6]:

- licensing precisely defined radio equipment, its location and technical characteristics;
- licensing apparatus to operate in a defined frequency band; and
- granting rights of use by means of exemption regulations.

6.2.3 *Licences which precisely define the radio station, its location and technical characteristics.* In many cases licences prescribe key parameters such as antenna height, precise location and transmitted power. They typically also define a basic set of characteristics used to define the class of emissions from the apparatus, including type of modulation of the main carrier, nature of the signal(s) modulating the main carrier, and the type of information being transmitted. In some cases, they also prescribe details of the signal, and/or the nature of multiplexing (for example CDM, FDM, TDM[7]). For example, Private Business Radio licences are defined in this way.

6.2.4 To date this specificity of licence conditions has been necessary for site clearance, and where appropriate for recording assignments in national and international frequency registers. However, it may restrict the scope of trading because it would mean that licences could only be acquired to be used for exactly the same use – in terms of application, technology or even licensee's line of business. For this reason, alongside the introduction of trading, Ofcom is proposing to make clear the circumstances in which it would expect to permit changes to these conditions on application by a licensee.

6.2.5 *Licensing apparatus to operate in a defined frequency band.* A second category of WT Act licences is defined in terms of rights to use equipment that operates in a particular frequency band (as opposed to an assigned frequency). Some also specify rights to use spectrum in a particular geographic region of the UK. Although the spectrum is 'block cleared' (i.e. co-ordinated *en bloc*) the technical characteristics are often defined in detail, and

6. Special forms of licence also exist, including: Test and Development, Temporary Licences and Short Term Aircraft Radio licences.
7. CDM, code division multiplexing, FDM, frequency division multiplexing and TDM, time division multiplexing

individual transmission stations still need to go through a site clearance process. This approach to rights is more flexible and is therefore more suited to trading. For example, cellular telephony licences are defined in this way.

6.2.6 *Granting of rights of use by exemption regulations.* Regulations adopted exempting specified apparatus and/or frequency bands from the requirement to obtain a WT Act licence are currently quite prescriptive. Technical characteristics of apparatus are well defined by the relevant national Interface Requirements, however licences are not required for individual apparatus. For example, Wireless LAN services are authorised in this way. Apparatus operates on a non-interference and unprotected basis. The nature of these rights of use is such that they cannot be traded in the way contemplated by the Communications Act.

Duration

6.2.7 Different licences currently vary in the way their term is defined. In general, licences currently issued fall into three broad types:

- *Those that are issued annually, and re-issued on renewal as a fresh licence or licence validation.* For example, on-board maritime and CB radio licences fall into this category.
- *Those that are issued without specific time limitation.* For example, cellular and certain PAMR licences fall into this category. These are subject to payment of an annual fee and where the licensee fails to pay the fee, the licence may be revoked. However, the licences are not 'renewed' as such. These licences have no explicit statement in the licence of how long they should continue. The circumstances in which revocation may take place include failure to pay applicable fees, or other breach of licence conditions, or reasons relating to national security or compliance with international obligations. It is generally current practice that licences will continue in force until revoked by the Secretary of State or surrendered by the licensee. In practice this has led to an expectation that significant notice may be given if there is an intention to revoke the licence. This expectation may reflect the required levels of investment or costs of relocating to alternative spectrum. However, currently the Secretary of State has the right to terminate such licences for reasons related to the management of the spectrum where one year's notice has been given and the Secretary of State has considered any pertinent factors. This lack of regulatory certainty over licence term could significantly hinder the introduction of trading in these licence classes.
- *Those that have been auctioned.* The licence term is much more clearly defined in those licences that have been auctioned, as their maximum term had been explicitly stated at the point of award. For these licences there is no expectation that licences would continue beyond the stated maximum licence term.

Change of ownership

6.2.8 Currently, all licences state that the licence is non-transferable. However, where the licence holder is a company, there is implicitly no restriction on changes of control of the licence holder. In addition, there have been a number of cases in the past where the Secretary of State has agreed to cancel an existing WT Act licence and reissue the licence in substantially the same terms to the purchaser of the business of a licence holder. While this process has been used in a number of individual cases, there have been no comprehensive guidelines on the circumstances in which the Secretary of State would consent to reissue a WT Act licence to a new licensee. This has generated a high level of uncertainty and may

have deterred potentially efficient transactions. At the simplest level, Ofcom intends that the introduction of spectrum trading should result in a more transparent and certain process for the transfer of rights to use spectrum.

Other licence conditions

6.2.9 Some licences have other conditions attached to them that are intended to address spectrum efficiency, public policy and competition matters. These include, for example, roll-out conditions in 3G WT Act licences.

6.2.10 In some instances WT Act licences specify the nature of the telecommunications service to be provided or the purposes for which the radio equipment may be used. For example, private business radio licences have conditions that restrict use to services such as a taxi communications or for business security purposes. Such service limitations would limit the ability of a user to trade their right of use except where it is to a company carrying out similar activities. For example, even if their licensed right was made transferable, a private business radio licence which specified that the user should be a taxi company could only be sold to another taxi company.

6.3 Definition of rights which may be traded

6.3.1 In a trading environment, a much greater degree of clarity will be necessary over what a right to use spectrum implies in practice. Ofcom is proposing to achieve this by a combination of changing licence conditions to make them clear and consistent, plus clear policy guidance on what licensees may expect of Ofcom.

6.3.2 As a result of the Communications Act 2003 (which is intended to implement the EU Authorisation Directive), the conditions which may be attached to WT Act licences must be (a) objectively justifiable in relation to the networks and services to which they relate, (b) non-discriminatory, (c) proportionate and (d) transparent in relation to what they are intended to achieve. Ofcom will, therefore, consider whether existing restrictions in WT Act licences continue to meet these criteria and, where that is not the case, will remove such restrictions from licences.

6.3.3 Ofcom is proposing that rights to use spectrum should, where possible, be defined in terms of physical parameters, such as transmitted power and spectrum mask, rather than technology or usage-dependent parameters.

6.3.4 Ofcom intends to create a licensing regime which provides the appropriate framework for trading. In doing so it will need to address four main areas, which are discussed in the following sections. They are:

- *Transmission rights:* definition of the rights to transmit in a technology-neutral or service-neutral manner;
- *Interference:* publication of guidance levels of interference for each licence class, and a mechanism for ensuring that interference issues are considered in a timely and cost-effective manner;
- *Licence term:* clarification and definition of the terms of licences; and
- *Licence termination:* clarification of the circumstances in which licences may be terminated.

6.3.5 In addition, Ofcom is proposing to distinguish between spectrum-related licence conditions (which must be transferred together with rights to use spectrum) and non-spectrum-related conditions (which may or may not be transferred).

6.3.6 In reality, this definition of a tradable right cannot be applied to all licence classes. For licence classes where there are very large numbers of existing licences, the benefits of making some of these changes do not justify the costs. Section 9 describes the licence amendments that Ofcom proposes to make for individual licence classes.

6.4 Transmission rights

6.4.1 Ofcom is proposing is that WT Act licences which have been adapted for spectrum trading would define the right to transmit in terms of transmitted power or equivalent isotopically radiated power (eirp) [8] and a 'spectrum mask'. The right to transmit may also be specified in terms of conditions experienced at a defined geographic and/or frequency boundary. Together, these conditions should be broad enough to be technology-neutral, but sufficiently tightly defined that geographic boundaries could be managed effectively.

6.4.2 Ofcom is proposing to define these boundary conditions in terms of common physical engineering dimensions (e.g. Watts per Hertz). Spectrum masks in different licence classes may need to be defined using different parameters. For example, a definition using power spectral density will be suitable for many licence classes, but not all. Annex C discusses the manner in which the spectrum mask may be defined.

6.4.3 Exhibit 3 below outlines a potential set of boundary parameters, which could define generic radio frequency use.

Exhibit 3: Boundary parameters – transmission

- Time – particularly relevant if rights to use spectrum are transferred to other users for specific periods of time
- Location of geographical boundaries – specified as vertical planes between two grid references
- Frequencies over which the right extends – i.e. specification of the frequency boundaries. Would take into account the characteristics of the emission and manner in which it is designated (including rules for guardbands where needed)
- Maximum in-band power flux density (PFD), field strength or other such measure.
- Maximum out-of-band PFD at boundary and mid-point at the guard band
- Relevant interference mitigation factors (e.g. site shielding etc.)

8. A theoretical measure of the power of a transmitter that radiates equally in all directions.

6.4.3 Defining the right to use spectrum in this manner permits users to re-specify the right – for example, by 'sub-dividing' their rights to use spectrum and only transferring those rights relating to a specified sub-band or geographical area.

6.4.4 In some licence classes there are large numbers of licences covering relatively small amounts of spectrum in a highly interleaved manner. For example, Private Business Radio licences fall into this category. Because of the interleaved nature of these assignments, it would be very expensive to redefine transmission rights in this way. The potential benefits of doing so are unlikely to warrant this expense, as these licences are typically relatively low value. Therefore, for these licence classes transmission rights would continue to be defined as now. However, Ofcom is proposing to amend the term of these licences, as discussed in Section 6.6. For many of these larger licence classes, Ofcom is proposing to alter certain licence conditions through revision of the wireless telegraphy general licence conditions booklet which is currently issued by the RA.

6.4.5 Ofcom believes its proposed approach to defining transmission rights will provide licence holders with sufficient flexibility to re-define and customise their spectrum assignments in the optimal manner through trading. An alternative approach, using standardised 'frequency trading units' – discrete blocks of spectrum defined by frequency, time and geography – as the unit for all trades, is not proposed. Ofcom believes that these would reduce the flexibility to tailor spectrum usage to individual needs and reduce the efficiency of use without offering substantial advantages in terms of ease of trading.

6.4.6 Initial assignments (i.e. previously unassigned spectrum introduced to the market) will similarly not be made up of standardised frequency trading units. In such cases, WT Act licences will refer to the entire assignment of spectrum and will specify the initial use of the spectrum. Parties will then be able to divide up licences through any subsequent trades should they wish.

Question 7:

(a) Do you anticipate problems in defining the right to transmit in terms of transmitted power or equivalent isotopically radiated power and a 'spectrum mask', and if so what?

(b) What alternative approaches (such as standardised frequency trading units) would you prefer?

6.5 Interference

6.5.1 Protection from undue interference9 is of critical importance to users of the spectrum. Ofcom intends to publish guideline levels of interference for each licence class, and to establish a mechanism for ensuring that disputes regarding interference from third party radio equipment can be considered in a timely manner.

6.5.2 In a more liberalised environment there may be a greater chance of undue interference as a result of users making changes to the use of their licences. While there may be more activity in resolving interference issues, Ofcom will endeavour to ensure that it remains possible to achieve satisfactory protection for all spectrum users, on the basis of the proposed mechanisms for approving proposed changes of use and for resolution of disputes.

6.5.3 At present, licensees rely upon the Secretary of State (advised by the RA) to assign licences in such a way that licensees are protected from undue interference. The RA makes each assignment taking into account the implications for the interference environment. In the event of interference occurring, and depending on its nature and source(s), the RA seeks to work with the

9. The Communications Act 2003 section 183 amends the definition of this term used in licences (see Glossary)

parties concerned to resolve the matter. The processes for this are well established, and vary according to whether the source of interference is in the UK or elsewhere.

6.5.4 In an environment where licensees may wish to trade their right to use spectrum, Ofcom may need to provide a more structured approach to resolving disputes which arise in relation to interference, and to provide clearer guidance as to when and how it will seek to resolve such disputes.

6.5.5 In order to provide guidance to WT Act licence holders, Ofcom proposes to provide an indication of the level of undue interference a licensee may experience which may trigger an interference dispute. This guideline will be defined in a manner which mirrors, as far as possible, the parameters by which the transmission right is defined, as set out in Exhibit 3. This guideline level of undue interference will be specified on a licence class by licence class basis. In many cases, for reasons similar to those outlined in the discussion of the 'spectrum mask' above, it may be very difficult to characterise undue interference. It is probable that a definition of undue interference would also need to include a parameter defining a proportion of time and/or locations beyond which this level of interference may be considered 'undue'.

6.5.6 Ofcom would not generally expect to be involved in disputes where the level of interference experienced was below this guideline level. The interference guidelines would refer to levels of interference from equipment covered by the WT Act only.

6.5.7 Ofcom's dispute procedures, which would be triggered by interference above this guideline level, are described in Section 8.4.

Question 8:

(a) How important is it to provide guidelines on levels of interference for each licence class?

(b) Do you anticipate any problems in doing this, and if so what?

(c) What alternative approaches might Ofcom adopt?

6.6 Licence term

6.6.1 There are a number of approaches that could be taken to defining the term of licences. A purist economic approach would be to grant perpetual rights, as these would provide the maximum certainty to owners and facilitate greatest economic efficiency. However, this would present difficulties for the management of spectrum, which has to have regard to considerations such as spectrum efficiency, international agreements and harmonisation, public policy and competition matters.

6.6.2 Alternatively, licences could continue in force until revoked by the Secretary of State, or in future Ofcom, as many of them are today. In reality, these licences are currently terminable in a wide range of circumstances on relatively short notice. In particular, such licences may generally be revoked for reasons related to the management of spectrum on one year's notice in writing. The RA has, in fact, exercised this power in a manner which has reflected the required levels of investment and/or costs of relocating users to alternative spectrum. To provide certainty for trading, it will be necessary for Ofcom to provide as much guidance as possible on the circumstances in which it may terminate licences.

6.6.3 Ofcom is proposing that, in general, licences would have a rolling term, that is, they would continue subject to certain rights which Ofcom would have to terminate them. With certain exceptions, Ofcom would give notice of termination in

accordance with a notice period which would be defined in advance and stated in the licence.

6.6.4 Although the exact notice period may need to be determined on a case by case basis, Ofcom proposes that a standard notice period of five years would be applied in licence classes where tradability is introduced. Ofcom believes that this approach broadly reflects current practice, both where licences are annually renewable and where licences continue subject to notice periods. It reflects, among other things, typical equipment lives and requirements for migration of affected users.

6.6.5 Potentially, such notice periods could be set on a band by band basis and/or licence class by licence class, depending on the equipment lives and the use to which the spectrum was put. However, there would be some disadvantages to such an approach. In an environment in which licensees have greater flexibility to change the use of their spectrum, there is no reason to base different notice periods on current usage. Where the use of a licence was changed, the notice period of that licence would either have to be changed to reflect the new use, or the notice period would cease to be appropriate, with different operators of the same service having licences with different notice periods. Neither of these are desirable; they may distort the market, make it more difficult to use spectrum flexibly for different applications, and present barriers to the reconfiguration of licences.

6.6.6 Auctioned licences and broadcasting licences will differ in their treatment. In the case of auctioned licences, the terms of the licence were defined at auction. These will remain unchanged for the duration of the auctioned term. In the case of broadcasting, WT Act licences are provided to enable Broadcasting Act licensees and the BBC to deliver their obligations under Broadcasting Act licences or Charter. It would be inappropriate for their associated WT Act licences to have different term. Ofcom therefore proposes to amend the term of WT Act licences to reflect the termination date of the Broadcasting Act licence to which they relate. On termination, the licences will revert to Ofcom for reassignment, in line with the current terms of the licence.

6.6.7 This approach to the term of licences is designed to respect the current rights and concerns of licensees, and to articulate these in a clear fashion. It is not intended to be a grant of a substantial new right or value in relation to spectrum. However, in licence classes where tradability was to be introduced, licences would need to be amended to reflect this new notice period.

6.6.8 Licence terms for new assignments of spectrum are discussed in Section 7.6.

Question 9:

(a) Do you agree that on the introduction of trading, current licences should have a rolling term with a defined notice period for termination?

(b) What notice period do you think would be appropriate?

6.7 Licence termination

6.7.1 Under the WT Acts (as amended by the Communications Act 2003), Ofcom will have very broad rights to terminate WT Act licences. Ofcom's right to terminate by notice in writing may be subject to certain restrictions contained in WT Act licences. A number of WT Act licences (e.g. 2G and 3G licences) contain such terms. To the extent that such restrictions currently exist in WT Act licences, Ofcom is not proposing that they should be removed.

6.7.2 Ofcom understands the importance of providing guidance as to the circumstances in which it would expect to exercise its statutory powers to terminate licences. This guidance is required in order to give licensees and potential purchasers certainty over their investment decisions. Ofcom proposes to provide this certainty to licensees through issuing policy guidance, rather than by amending licence conditions. However, Ofcom, as a public body, cannot fetter its ability to make the appropriate decision in any case which may arise in the future, where it will be required to act in accordance with its statutory duties.

6.7.3 Ofcom's current view is that there are limited, broad circumstances in which Ofcom is likely to use its statutory powers to terminate a licence either upon short notice (i.e. one month or less), or after a longer period of notice (i.e. the defined notice period). This section discusses these in turn.

Immediate revocation of licences, revocation on short notice or close down of station

6.7.4 Under the WT Acts, Ofcom has the power to revoke any WT Act licence at any time where it appears requisite or expedient in the interests of national security, or for the purposes of compliance with a Community obligation, international agreement or arrangements to which the UK is a party. This power cannot be limited by the terms of any WT Act licence.

6.7.5 In addition, the RA has generally reserved the right to terminate a WT Act licence immediately or on short notice in the following circumstances:

- non-payment of annual fees and/or auction installments;
- material breach of any of the terms of the WT Act licence;
- breach of auction rules; and
- revocation, suspension or lapse of certain related licences or authorisations (e.g. revocation of an associated Broadcasting Act licence).

6.7.6 Immediate close down of radio transmissions may be needed so as to alleviate undue interference to others and to allow remedial action to take place.

6.7.7 Under the WT Act 1949 (as amended by the Communications Act 2003), where Ofcom is proposing to revoke a WT Act licence it is generally required to give licence holders an opportunity to make representations. Where there has been a breach of the terms of a WT Act licence, Ofcom is required to provide an opportunity to remedy the breach within a specified period. In general, this period will be one month, although Ofcom may specify a longer or shorter period where it considers this to be appropriate. In order to ensure that enforcement action is taken in a timely manner, Ofcom will generally only have a further month in which to decide whether or not to revoke the licence.

6.7.8 Although Ofcom will consider each case on its merits, Ofcom currently expects to reserve the right to revoke licences in similar circumstances to the RA. In addition, breach of the Trading Regulations that Ofcom will draw up to regulate the spectrum market may constitute further grounds for revocation.

Notice given by Ofcom of licence termination

6.7.9 Ofcom expects that it would generally only serve notice on licensees in accordance with the defined notice period outlined in Section 6.6 in four circumstances related to spectrum management.

6.7.10 First, Ofcom may serve notice where there is a requirement for change of use in a band owing to a Community measure (that is, an EU directive,

decision or regulation) or other international agreement or arrangement to which the UK is a party. Although Ofcom has the legal powers to revoke the licence in such a situation without notice, Ofcom would generally expect to serve notice to the current occupants of that band in accordance with the terms of their licences.

6.7.11 Second, Ofcom may serve notice where the Secretary of State issues an order under the Communications Act directing Ofcom to take certain actions. For example, the Secretary of State may direct Ofcom to reserve certain frequency bands or make such bands available for certain types of users or uses, to exempt certain bands from the licensing requirement, or to take certain actions in the interests of national security, international relations or in the interests of public safety or health.

6.7.12 Third, Ofcom may serve notice that licensees are required to change frequencies where trading has resulted in inefficient fragmentation of spectrum. It is possible that a band could have become so fragmented that the transaction costs for any potential purchaser of consolidating the band would be prohibitively high. In such cases, Ofcom would expect to provide incumbent licensees with equivalent spectrum on a more efficient spectrum utilisation basis, freeing up spectrum which could then be assigned to new users. In general, it is envisaged that incumbents would not have to compete for their new frequencies through a competitive market-based process in these circumstances.

6.7.13 Fourth, Ofcom may serve notice where it is necessary to do so in order to secure the achievement of its statutory duties, in particular its general duty to further the interests of consumers in relevant markets. For example, owing to reasons of failure of the spectrum market, there may be a compelling economic case that it is in the interests of UK consumers to revoke licences in a particular band, and either reassign them or exempt the band from licensing. This may be because the spectrum market is failing to allow attractive new technologies to become established, or popular uses to expand, or because established technologies occupying spectrum are in decline. Ofcom would only take such a step acting in a fair and reasonable manner, after consultation with incumbents and new entrants, and having regard for incumbents' economic interests and those of their customers.

6.7.14 If notice is given and reassignment of spectrum is required, Ofcom will typically reassign spectrum through competitive market processes, as described in Section 7.6.

Question 10:

(a) In what circumstances do you believe it would be appropriate for Ofcom to revoke or serve notice on licences?

(b) certainty to licensees and potential purchasers and sufficient flexibility for the necessary management of the spectrum by Ofcom?

(c) Are there circumstances in which it might be appropriate for Ofcom to have a power to terminate licences on shorter notice, with compensation?

6.8 Non spectrum-related licence conditions

6.8.1 Some WT Act licences contain conditions, such as roll-out requirements, which are not directly spectrum-related. These are positive obligations which do not directly define the right to use the spectrum. However, they are part of the licence 'package' that the licensee took on (and in many cases paid for) at the time the spectrum was assigned.

6.8.2 It is possible that a licensee might be able to meet these obligations without using all the spectrum assigned to it, or by exchanging spectrum with another party. Ofcom is proposing that these licensees should be able to trade the parts of their spectrum that they do not require.

6.8.3 In these circumstances, Ofcom accepts that the licensee may wish, for example, to transfer rights to use this excess spectrum free from the associated roll-out obligation. Ofcom considers there are certain obligations (e.g. in relation to maximum permissible emissions) which must necessarily be transferred with the related rights to use spectrum. However, there are other obligations (e.g. roll-out commitments) which, in principle, would not need to be transferred in all cases.

6.8.4 If the initial holder retained these obligations for itself, it would be for the licensee to ensure that it retained enough appropriate spectrum to fulfil its obligations. If the obligations were passed on, the new owner would have to have the appropriate financial, technical and spectrum resources required to meet the obligations. In either case, Ofcom would need to assess whether the proposed holder of the obligations was adequately placed to meet them.

6.8.5 Ofcom is proposing that, if it deemed that the trade appeared likely to threaten the fulfilment of these obligations, either because the original licensee retained insufficient spectrum to fulfil its obligations, or because the recipient was not deemed fit to take the obligations on, Ofcom should have the power to prevent the trade.

Question 11:
What problems do you anticipate in separating non-spectrum licence conditions (such as roll-out obligations) from spectrum-related licence conditions, and allowing licensees to pass on their obligations as part of a trade should they wish?

Section 7

Market Mechanisms

7.1 What this section covers

7.1.1 This section sets out the proposed mechanisms by which a spectrum market should function and the role of Ofcom in facilitating and supporting trading. It is structured into five parts:

- Ofcom's role in the market;
- role of intermediaries;
- availability of trading information;
- trading processes; and
- primary assignments.

7.1.2 Ofcom proposes to limit its role in the spectrum trading market to regulatory functions. Ofcom does not anticipate being a party to trades (other than as the primary issuer of spectrum new to commercial uses). Ofcom will not act as a point of exchange, either by provision of trading information (e.g. identities of interested buyers or sellers), nor through acting as a party or broker to trades.

7.2 Ofcom's role in the market

7.2.1 Ofcom will seek to limit its role in trading to regulatory functions, in order not to introduce distortions into a competitive spectrum market. As a general principle, Ofcom will not provide services that the market could otherwise provide.

7.2.2 Ofcom will continue to introduce spectrum into the market through market-oriented mechanisms of primary spectrum assignment, for example, auctions. With this exception, Ofcom does not propose to participate as a party to trading in any way.

7.2.3 Ofcom will regulate the operation of the market by requiring participants to comply with a set of Trading Regulations. These will be the means through which Ofcom will require parties to adopt the trading processes and regulation discussed in this consultation document. For example, they will describe:

- processes and timing for the administration of trades, including Ofcom's role and the relationships and legal obligations between parties to the trade (as discussed later in Section 7.5);
- processes for requesting Ofcom's approval for change of use and reconfiguration of licences (as discussed in Section 8.3);
- information that parties are required to make available, to Ofcom and to the counter-party in a trade, and information that Ofcom will make public (as discussed in Section 7.4);
- Ofcom's dispute resolution procedure (as discussed in Section 8.4);
- the competition rules relating to spectrum trades (as discussed in Section 8.5);
- rules for market intermediaries, covering issues such as disclosure of information, fair trading and ethical practice; and
- other regulations concerning the trading environment.

7.2.4 Ofcom will do what it can to facilitate the emergence of lively markets with depth and breadth of activity. For example, it will seek to ensure efficient administration of trading, with the minimum necessary scrutiny of trades. It would, at the request of the parties and upon receiving appropriate evidence of the transfer, register changes of ownership through modification of its registry of spectrum assignments (described in Section 7.4). It would reissue licences to reflect such changes. It would ensure that appropriate licensing information is publicly available and accessible. It will also regulate the activities of intermediaries involved in the trading of rights to use spectrum, who would be required to abide by the Trading Regulations in order to participate in trading.

7.2.5 If more complex trading instruments were to emerge (e.g. futures and options), trading in such instruments might be deemed to have a primarily financial purpose, and regulation of these instruments may fall under the remit of the FSA. Should trading in such derivative products be contemplated, any parties to these proposed trades should contact the FSA before entering into them to ensure that they do not find themselves in breach of any financial services laws or regulations.

7.2.6 Ofcom will take a close interest in the development of the market and will gather information on trades, volumes and prices, in order to review the progress of spectrum trading and make any necessary refinements to the Trading Regulations and related administrative processes. It also proposes to publish this information in aggregate for public use.

7.3 Role of intermediaries

7.3.1 In theory, central exchanges provide maximum disclosure of information (including price and known point of access to available liquidity), and benefit commodity trading. They overcome the asymmetries of information which exist in bilateral trades and facilitate trading between disparate and otherwise unconnected parties.

7.3.2 In practice, a single central exchange is most effective for high volumes of trading in a homogeneous product, whereas spectrum is highly differentiated, and an imperfectly substitutable commodity, outside defined bands (though technical developments may change this). The volumes of trading are uncertain and the nature of trading is likely to be heterogeneous. Ofcom expects that spectrum trading will be more analogous to the property market, which functions through a combination of bilateral and broker-mediated trades, without a central exchange. While volumes of trading or leasing may be quite high in specific categories of licence (for example among programme-makers and for special events), for the most part volumes are expected to be relatively small compared with markets benefiting from central exchanges.

7.3.3 However, a broad range of market institutions, including central exchanges, may emerge. Ofcom will not itself act to establish exchanges, market makers or brokers, except by ensuring that relevant information is available. All participants in spectrum trading, whether they are intermediaries or direct users of spectrum, will be obliged to comply with Ofcom's Trading Regulations. The types of intermediary that may emerge include:

- *Brokers*. These would be akin to estate agents who seek buyers and sellers for parties wishing to trade spectrum. The broker would not own spectrum during the trade, and the trade would proceed on a bilateral basis between the seller and the buyer.
- *Market-makers*. These would be holders of inventories of licences, taking positions with a view to trading out to a long-term buyer, or another trader. Depending on the evolution of a spectrum trading market, it is possible that traders may begin to trade rights of use through more complex financial instruments such as options. This activity would be welcomed by Ofcom, if the market evolves in this way, as it might provide liquidity in a similar manner to market-makers in stock markets.
- *Spectrum management organisations*. These are discussed in the section below.

Question 12:

(a) What intermediaries do you expect to emerge in the market for spectrum licences?

(b) Are there any features of intermediaries which may require regulation?

Role of Spectrum Management Organisations

7.3.4 Spectrum Management Organisation (SMO) is a general term for operators who undertake the management of certain blocks of spectrum. This spectrum may be particularly dynamic or complex in its management requirements – for example, spectrum commonly used for programme-making and special events or private business radio. SMOs would acquire rights to use blocks of spectrum, which they would hire to users as required, such as for particular events or in order to meet a flexible requirement. They would have a different role from Ofcom in managing spectrum; for example, some SMOs may operate by disaggregating national bands into regional blocks for users.

7.3.5 There are a number of particular issues in regulating SMOs. Firstly, there may be difficulties controlling interference – particularly out-of-band interference – because of their rapidly changing usage requirements. Secondly, an SMO may exploit its monopoly position, if customers leasing spectrum from an SMO have limited opportunities to switch to alternative frequencies or providers, either because of shortage of suitable alternative spectrum or because they own equipment that works only on one frequency.

7.3.6 SMOs may emerge naturally in the market. Ofcom does not propose proactively to establish any. However, there are a number of third party organisations who currently manage spectrum on behalf either of the Radiocommunications Agency or of their licensee. These SMOs exist in three licence categories, as shown in Exhibit 4.

7.3.7 Ofcom's relationship with these organisations may need to change so that they can adapt to a trading environment. Ofcom proposes to treat the three cases separately with regard to the introduction of trading. These are discussed below.

7.3.8 In the case of **programme-making and special events**, some time after 2005 (at the end of JFMG's current contract), it is proposed that treatment of the programme-making spectrum be amended to take account of the future trading environment. One option may be to identify a viable amount of spectrum that could be used for programme-making, possibly on a shared basis with other users. This could be assigned through a competitive process to one or more licensees. The licensee(s) would be free to provide access to the spectrum to programme-makers and other potential users at prices determined by the market. They may also wish to supplement their primary assignments of spectrum with spectrum leased from other primary licence holders to meet demands of customers. In order that they can use any spectrum they obtain for programme-making and special events flexibly, it is proposed that they would be able to apply for an overlay right to change the use of any spectrum they obtain for their defined purpose.

7.3.9 Further details of Ofcom's proposed approach to programme-making spectrum are set out in Section 9.3.

7.3.10 **Scanning telemetry** frequencies are currently licensed to the water, electricity and gas companies. The management of these frequencies is contracted out to agents; JRC (the Joint Radio Company, a joint venture between National Grid Transco and the Electricity Association) in the case of gas and electricity, and CSS (a private company) in the case of the water companies.
It is proposed that Ofcom should confer tradability and the ability in principle to change use and reconfigure these licences to the current licensees, namely the utility companies.

Exhibit 4: Spectrum licences currently administered by 3rd parties

Licence class	No. of licensees	Current arrangements
Programme-making and special events	2,320	• JFMG Ltd. (owned by the ITV network and and the CRCA) is subcontracted by the RA to manage the assignment and licensing of spectrum to programme-makers and organisers of special events who use radio-microphones and radio-cameras etc. • JFMG uses spectrum from Band I to 48 GHz, including interleaved television broadcasting spectrum for licensing a range of mobile and (largely temporary) fixed link operations • JFMG has a primary spectrum assignment of its own and uses *ad hoc* access to other spectrum, including that used by other primary rights holders
Scanning Telemetry	66	• National channels which are licensed to the utilities • The utilities subcontract management of these frequencies to the JRC, in the case of gas and electricity, and to CSS for water
Aviation	approx. 11,000	• The CAA issues licences for all aviation users, including on-board communications, on-board navigational aids and ground-based communications • The CAA manages assignments and issues the licence document on behalf of RA – however, the RA is the licensing authority and retains responsibility for licensing

7.3.11 It is possible that the nature of the relationship between the licence holders and their agents CSS and JRC may change as a result of the introduction of trading. For example, CSS and JRC may wish to become brokers of the spectrum they manage, on the licence holders' behalf. However, Ofcom believes that such activity should be determined by the terms of the commercial arrangements between the parties concerned.

7.3.12 Currently, CSS and JRC process assignments and schedule documentation required by the RA. Ofcom does not envisage a change to this arrangement when the RA's functions transfer to Ofcom, and proposes that responsibility for these administrative processes should remain with the licensee(s) and their agent(s) when trading commences.

7.3.13 **Aeronautical spectrum** is currently administered by the CAA on behalf of the RA, which remains the licensing authority. It is envisaged that this situation should continue, owing to the associated benefits of linking with the CAA's other regulatory processes. The CAA would continue to administer licences and undertake spectrum and frequency management for aeronautical bands. Upon the introduction of trading for ground based frequencies, it is proposed that registration of trades and technical scrutiny of potential changes of use by licensees (within the scope of international harmonisation decisions) should be assessed by the CAA in conjunction with Ofcom. Further details of Ofcom's proposed approach to aeronautical spectrum are set out in Section 9.7.

Question 13:
Do you agree with Ofcom's proposed arrangements for the spectrum currently managed by JFMG, JRC, CSS and the CAA?

7.4 Availability of trading information

7.4.1 In general, markets function most efficiently with maximum availability of information, because they benefit from the transparency and certainty this brings. In the case of spectrum markets, this will include information about actual spectrum assignments, intentions to buy and sell, and historic trades and prices. Under the Communications Act, Ofcom will have certain powers to specify requirements regarding records of spectrum trades, which may be made public. Ofcom will also have a duty to establish a register of licensing information ('Spectrum Registry'), which may include information on the transfer of rights and obligations under WT Act licences and grants of RSA. Finally, Ofcom will be under a duty to publish a UK Plan for Frequency Authorisation, which will set out the purposes for which different frequencies have been allocated and the frequencies which are available for assignment.

7.4.2 For this reason, Ofcom proposes to make available to the market much of the licensing information it holds. Ofcom will not provide information regarding intentions to buy and sell, nor details of individual transactions that have taken place. It may, however, aggregate and release information about the general functioning of the market that it collects in the course of its duties, for example total annual volumes of trades by licence class and possibly pricing trends.

7.4.3 If the market has a need for further information, intermediaries are likely to emerge to augment the basic information made available by Ofcom. For example, brokers (like estate agents for land) may publish information about intentions to buy and sell spectrum. Technical advisors may assist participants in technical due diligence and providing guidance regarding future technical developments and harmonisation proposals.

7.4.4 Ofcom is not proposing to offer e-trading systems to the market. If there is a demand, such systems could be expected to emerge in the market. However, for certain spectrum classes it may offer access to technical assignment tools such as MASTS (the RA's electronic assignment system used for private business radio systems), to assist the regulatory functions required for reconfiguration and change of use.

7.4.5 Ofcom proposes that there are two levels of information that it will make available:

- Information on who owns what, including some details about those licences, to facilitate trading. Ofcom proposes to publish this information as part of its Spectrum Registry, which will be available on its website.
- Parties carrying out due diligence on a particular licence, or preparing technical assessments of proposed changes of use, may wish to request more detailed information from Ofcom. For example, this might include details of transmission rights that are contained in the licences of co-channel, adjacent channel or co-located licensees, and of guideline levels of interference. It may also include the terms of memoranda of understanding which the UK has entered into with neighbouring jurisdictions which relate to interference co-ordination. Ofcom will introduce a system which will allow WT Act licensees to request such information in writing.

7.4.6 In addition, a range of important ancillary information concerning the market context of spectrum trading will also be made available. This might include non-confidential information regarding its plans for management of the radio spectrum – for example, adoption of harmonisation decisions, future proposed primary assignments and any relevant technical or regulatory developments which might impact market participants' decisions. Ofcom is considering further how the publication of this information will be integrated into the UK Plan for Frequency Authorisation, and on the orders on limitations of spectrum use, which it is required to publish under the Communications Act.

7.4.7 The remainder of this section describes these two information sets in more detail.

Information published on Ofcom's website

7.4.8 Ofcom proposes that information regarding ownership of spectrum licences and their characterisation, in terms of geography, frequency ranges and any shared use, should be made available in the Spectrum Registry on Ofcom's website. Section 170 of the Communications Act enables Ofcom to publish a wireless telegraphy register, but it will need to adopt regulations to establish this.

7.4.9 Exhibit 5 outlines the data fields that Ofcom might publish in the public Spectrum Registry.

Exhibit 5: Public Spectrum Registry – example of contents

Data field	Description
Name of licensee	Name of the individual or enterprise holding the licence (as notified to Ofcom)
Contact details	Postal and email addresses and telephone numbers for correspondencewith the holder of that licence
Current use	Description of the current application of the licence
Frequency boundaries of right	The radiofrequency range of the assignment – specified either: • in terms of a central frequency with channel width, e.g. 415.25MHz ± 100kHz, or • a frequency range, e.g. 415.15 to 415.35MHz
Geographical boundaries	Specification of the geographical characteristics of the right, either: • in terms of boundaries specified as planes between grid references, or • a radial boundary a specified distance from a particular grid reference
Power	Statement of any power restrictions on the licence, particularly for apparatus specified licences, e.g. • equivalent isotopically radiated power, (eirp) at the specified location, or • effective power flux density at the specified boundaries
Guard bands	Specification of the frequency range of any guard bands associated with that assignment
Authorised use	Description of the restrictions of use of the licence, e.g. • harmonisation restrictions, or • other restrictions defined in the licence, e.g. changes of use permissible only within the constraints of MASTS for PBR,or • other technical limitations on the nature of transmissions
Other obligations or conditions	Statement of any non-spectrum obligations under the licence, e.g. roll-out obligations
Administrative Incentive Pricing	The annual AIP payable by the licensee

7.4.10 Security and confidentiality considerations will restrict the information that Ofcom can make available. For example, Ofcom does not expect to be entitled to make available information about many MoD assignments.

7.4.11 It should be noted that where trades involve companies which are publicly listed, or quoted on the Alternative Investment Market (AIM), commercially sensitive information such as the agreement of a trade may first be required to be released through a Regulatory Information Service approved by the FSA or the London Stock Exchange, as appropriate. Ofcom would then update the Spectrum Registry to take account of the new ownership details, only after the required announcements have been made.

Information available on request for due diligence processes

7.4.12 Parties to a proposed trade may wish to conduct a due diligence process prior to the trade. In certain cases, the parties may require access to technical information held by Ofcom. In particular, parties may require information regarding licence conditions, patterns of transmissions and guideline interference levels for co-channel users, co-located users or adjacent channel users. This will also be necessary in order to undertake suitable technical assessments for change of use and reconfiguration. While some of this information will be available on the Spectrum Registry, much of the information is likely to be highly detailed and bespoke to particular trades.

7.4.13 Ofcom proposes to introduce a system which will allow WT Act licensees to request such information in writing, setting out reasons for the request. Such an arrangement will also allow Ofcom to consider and respond individually to requests, and where appropriate to tailor the information provided to the needs of the applicant. In deciding whether to make the requested information available, Ofcom will need to take account of any confidentiality or security considerations and will generally expect the recipient to agree to certain terms, including with regard to confidentiality and limitation of liability. The requesting party will be expected to meet Ofcom's costs in providing this information.

Question 14:
Do you agree with the extent of information that Ofcom is proposing to make available to the market?

7.5 Trading processes

7.5.1 Ofcom intends to enable the transfer of rights of use with minimum administrative burden on both participants and the regulator, in order that a rapid turnaround of trading requests may be achieved. However, Ofcom will have a continuing role in enforcing licence conditions, providing advice and assistance to those complaining of undue interference, and resolving disputes. This section describes the proposed processes for an individual trade, lease or hire, once tradability has been introduced.

7.5.2 In general, Ofcom is proposing to transact trades by cancelling or amending the seller's licence, and reissuing a licence to the purchaser. It is proposed that all licence obligations (other than non-spectrum-related licence conditions) must be transferred with the transferred rights, unless Ofcom consents otherwise. Ofcom's proposed process for transacting a trade has six stages, which are described in Exhibit 6 below. The process for approving reconfiguration or change of use of licences is described in Section 8.3

Exhibit 6: Proposed process for transacting a spectrum trade

1. The licensee decides what rights it wants to transfer (e.g. by an outright sale or lease). If the proposed transfer would involve a change of configuration (e.g. a partitioning of the spectrum assigned to the licensee) or a change of use, which the licensee wishes to effect in advance of the trade, the licensee can apply to Ofcom first (as described in Section 8.3)

2. The parties to the trade agree the terms of the transfer. Under the Trading Regulations, Ofcom proposes to require that the terms of the transfer must be set out in a written contract signed by all parties. The terms of the contract may be as simple or as complex as the trade requires. In drawing up the contract, Ofcom expects that the parties will wish to conduct the appropriate due diligence and obtain the appropriate representations and warranties. It is proposed that under the Trading Regulations, all licence obligations (other than non-spectrum related licence conditions) must be transferred with the transferred rights (including liability for any outstanding licence fees) unless Ofcom consents otherwise. In granting such consent, Ofcom will need to be satisfied that the proposed arrangements do not affect its ability to enforce the terms of the WT Act licences. Other obligations, for example to third parties, may also be transferred. The transferor will then sign a spectrum transfer form and pass this, together with its licence documentation, to the transferee upon signing of the transfer agreement.

3. The transferee will then be responsible for sending (1) the transfer form, (2) the existing licence documentation, (3) the signed transfer agreement and (4) a competition and regulatory notification (as discussed in Section 8.5) to Ofcom.

4. Ofcom will then check the documentation to ensure that the proposed transfer is consistent with (a) the Spectrum Registry , and (b) the Trading Regulations, including the requirements for competition and regulatory clearance (as described in Section 8.5). Should a full review of the proposed trade be required for competition clearance, this may take several weeks to complete.

5. Assuming that the proposed transfer complies with these requirements, Ofcom will then update the Spectrum Registry, revoke the transferor's existing licence, issue the appropriate licence to the transferee and, where appropriate, issue a new licence to the transferor (e.g. where rights to use spectrum have been partitioned). Subject to the terms and conditions agreed between the parties, completion of the trade is likely to occur at this point.

7.5.3 Trades between neighbours (in terms of geography or frequency) are likely to be a major source of the value that spectrum trading creates, especially in its early stages. Ofcom is proposing that the processes for trades between neighbours should be the same as for other trades.

7.5.4 Ofcom is anticipating charging the acquirer of rights of use a fee for the administration of the trade. This fee will be established on a cost-recovery basis.

Question 15:

(a) What problems do you anticipate in the process for administering spectrum trading?

(b) Do you agree with Ofcom's outline procedure?

Leasing and hiring processes

7.5.5 As described in Section 5.3, Ofcom intends to permit transfers of rights to use spectrum which are for a specified period of time (e.g. a 'spectrum lease'), and temporary hires, as well as outright sales.

7.5.6 In the case of spectrum leases, the original licence holder (the 'lessor') would transfer some or all of its rights to use spectrum to the lessee for an agreed period of time or until the occurrence of a particular event. At the end of the period agreed between the parties or when the specified event occurs, the specified rights and/or obligations would revert back to the original licence holder. There are a range of licensing arrangements which Ofcom could adopt to reflect the fact that, under a spectrum lease, the transferred rights will eventually be returned to the original licence holder. These include the following:

- The lessor would surrender its original licence which would be replaced by an overlay licence granted to the lessor and a limited licence (e.g. for a specified period) granted to the lessee;
- The lessor would retain its original licence and a separate, limited licence would be granted to the lessee; and
- The lessor would surrender its original licence, which would be cancelled, and a new licence issued to the lessee. A separate transfer would then take place upon the rights reverting to the lessor.

7.5.7 Ofcom is concerned to ensure that whatever process is adopted enables it properly to carry out its enforcement and dispute resolution functions and to minimise the transaction costs to the parties. Ofcom's current position is that the first option may give it the greatest flexibility, while providing the parties with an appropriate degree of certainty.

7.5.8 Spectrum hires would typically be for a very short period (for example, overnight or for a few weeks). As the installation or use of radio equipment without a WT Act licence is (subject to certain limited exceptions) a criminal offence, Ofcom is concerned to ensure that the parties to such hires are properly authorised. Ofcom is, therefore, proposing that there be a general requirement to notify it of hires in advance. Except where Ofcom has agreed otherwise, parties to these hires would be required to inform Ofcom of the scope and duration of the hire, the contact details of the hirer, and to provide the appropriate written evidence that the hirer is aware of and has agreed to comply with the obligations contained in the primary licensee's licence. However, with the exception of certain spectrum (e.g. spectrum on long lease from the MoD), parties to a hire would not require Ofcom's prior approval, and the hirer would not be issued with a separate licence.

7.5.9 In all cases, Ofcom would seek to ensure that the operator of transmission equipment (whether primary licensee, lessee or hirer) would be responsible to Ofcom for their own compliance with transmission and other licence obligations.

7.5.10 Time-limited transfers (such as leases or hires) would only be permitted to involve reconfiguration or change of use to the extent that the licence would permit the primary licensee to make such changes themselves. Just as changes of use or reconfiguration would require Ofcom's approval in advance if the licensee was proposing to make those changes themselves, Ofcom's advance approval will be required for all leases or hires that involve change of use or reconfiguration.

7.5.11 Ofcom anticipates that SMOs may emerge which buy or lease rights to use spectrum, then hire them on a short term basis for different purposes. Ofcom wishes to encourage this kind of activity, and recognises that in these circumstances, to require Ofcom to approve every hire involving a change of use would be intolerably burdensome. In such cases, SMOs of this nature should be able to apply to Ofcom for advance consent for certain specified changes of use. Such consent may be granted subject to certain conditions as to the maximum duration of the hire, and Ofcom would reserve the right to withdraw the consent where interference issues arise.

Question 16:

(a) What kind of leasing and hiring arrangements do you envisage arising?

(b) Do you agree with Ofcom's proposed arrangements for approval and registration of spectrum leases and hires?

7.6 Primary assignments

7.6.1 In the case of new blocks of spectrum, Ofcom will, in accordance with its statutory duties, consider whether it is appropriate to exempt the use of that frequency block from the requirement for a WT Act licence, on appropriate terms.

7.6.2 Where there is a need to limit the number of licences to be granted in a particular band, and especially where there appears to be excess demand for the available spectrum, Ofcom expects to continue to use market methods such as auctions as the primary method of assigning spectrum licences. In a market-based system of spectrum management, it will continue to be important to ensure fair, objective, non-discriminatory, transparent and competitive processes for the introduction of new spectrum to commercial uses.

7.6.3 Ofcom expects that the nature of these market methods will vary with the size and value of the assignment. For significant new blocks of spectrum, which have either a national or a regional dimension and where there are likely to be more competing players than can realistically be accommodated in the spectrum, they may involve custom-designed auction structures. For smaller blocks of spectrum, such as new spectrum for private business radio systems, they are likely to be designed to minimise transaction costs. For example, they may be advertised and offers sought on a single round basis.

7.6.4 The RA's policy has been to determine fixed terms for licences subject to auction, which reflect a generous estimate of technology life. In future Ofcom will consider the same licence structures for primary assignments along with others (such as rolling licence terms), with a view to allocating spectrum in the most efficient way and consistent

with the policy considerations of the day. This might include initial terms which reflect the need to provide sufficient certainty for investment in technologies which have long pay-backs. However, any change in Ofcom's approach to primary assignments would be subject to appropriate prior consultation.

7.6.5 Ofcom may continue to include particular obligations, such as roll-out requirements, in certain primary assignments, in accordance with its statutory duties. The rights of use associated with the new assignments would be tradable.

Section 8

Regulation of Radio Spectrum

8.1 What this section covers

8.1.1 Ofcom will regulate the radio spectrum to ensure optimal use of the spectrum, including protecting access to the spectrum for incumbent users without undue interference. It will ensure the availability throughout the UK of a range of communications services, and ensure fair and effective competition in the sectors that use radio spectrum.

8.1.2 In doing so, Ofcom will have regard to its duties under both the Communications Act and related legislation. In accordance with these duties, Ofcom will set out the regulatory framework within which users of the radio spectrum will generally be required to operate, including establishing a set of Trading Regulations for those wishing to trade rights to use spectrum.

8.1.3 This section outlines some of the key components of these regulations and assesses the implications of trading on technical regulation and policing of the spectrum. The section is structured in six parts:

- change of use and reconfiguration of licences;
- interference management;
- investigations and dispute resolution;
- ensuring effective competition;
- spectrum pricing; and
- taxation of trading.

8.2 Change of use and reconfiguration of licences

8.2.1 As described in Section 5.4, simultaneously with the introduction of trading, Ofcom is proposing to liberalise the use of spectrum, by providing a mechanism for licensees to reconfigure or change the use of their licences in order that they may pursue higher value uses of spectrum.

8.2.2 Ofcom's proposed mechanism for licensees to reconfigure or change the use of their licences is a two step process. First, for each licence class where trading has been introduced, Ofcom will issue clear guidance on the circumstances in which it would in principle accept requests for change of use or reconfiguration of licences, and the criteria it would expect to use in assessing such requests. Second, it will consider requests by licensees to make such changes on a case-by-case basis.

8.2.3 The WT Acts set out a procedure under which Ofcom may vary existing licence conditions, including at the request of the licensee. Ofcom, as a public body, cannot fetter its ability to make the appropriate decision in any case which may arise in future where it will be required to act in accordance with its statutory duties. However, Ofcom's guidance will clarify the factors which Ofcom would expect to take into account when deciding, on the facts of the each case, whether to make such amendments proposed by licensees.

8.2.4 Although the guidance will be provided on a licence class by licence class basis, there are a number of common considerations which Ofcom would expect to take into account in all cases in assessing proposed changes of use or reconfiguration. These are:

- international harmonisation arrangements and interference agreements;
- domestic public policy considerations; and
- co-ordination and interference.

8.2.5 This section outlines Ofcom's approach to each of these constraints.

International harmonisation arrangements and interference agreements

8.2.6 The international harmonisation of spectrum use may take place as a result of binding Community measures (e.g. EU directives, decisions or regulations) or as a result of other international agreements and arrangements to which the UK is a party. Under the EU Framework Directive, spectrum trading may not result in a change of use of spectrum that has been harmonised under Community measures. In developing its thinking on the implications of international harmonisation for spectrum trading, Ofcom will take account of the harmonisation and autonomy studies currently underway following the Cave Review.

8.2.7 Ofcom believes that in general the market and individual licensees are best placed to make decisions regarding use and technology, in order to achieve the most economically efficient allocation of spectrum to different applications. Ofcom is, however, conscious of the value of international harmonisation in providing certainty and scale in research, development and manufacturing of equipment through global and regional standards. Harmonisation benefits manufacturers, investors, operators and consumers alike. Ofcom is proposing to balance the ongoing benefits to the UK of harmonised spectrum allocations with the desire to minimise regulatory intervention and achieve efficient industry-led technical change.

8.2.8 Ofcom will also regularly review harmonised spectrum allocations. Where a technology has not taken off commercially, for example, it is important the that the spectrum is quickly made available for other uses.

8.2.9 In general, Ofcom expects that harmonised bands will be reserved for the harmonised use, and change of use beyond the harmonised definition will not be permitted. However, there could be certain exceptions to this principle. For example, in some cases spectrum in these bands may be temporarily or partially leased for alternative uses where this does not cause undue interference to the provision of the harmonised services.

8.2.10 Certain spectrum, such as on-board aeronautical and maritime communications, is harmonised for uses that may be incompatible with trading. It is not proposed to extend tradability to these kinds of licence classes.

Domestic public policy considerations

8.2.11 In some licence classes, there may be domestic policy objectives which justify the delayed introduction of tradability and liberalisation of spectrum use. This may be for two reasons. First, in some licence classes the early introduction of liberalisation could hinder other spectrum management policies or more general policy objectives that Ofcom is pursuing in accordance with its statutory duties. Second, where Ofcom is pursuing specific policies in certain licence classes, these policies could create uncertainty which may make the introduction of tradability and/or liberalisation ineffective. These licence classes include:

- broadcasting spectrum, where decisions regarding the future frequency planning for digital switchover are awaited;
- emergency services spectrum, which is undergoing ongoing rationalisation;
- 2G and 3G spectrum, where decisions over refarming of 2G spectrum, and possible future assignment of 3G expansion spectrum, are awaited; and
- PAMR spectrum, where a band reallocation is planned.

8.2.12 In principle, Ofcom may restrict the eventual extent of liberalisation that is permitted in certain licence classes in order to further public policies that it was pursuing in accordance with its statutory duties. In these circumstances, Ofcom would make clear as far in advance as possible what licence classes were affected and how. Were a new restriction of this nature to arise, Ofcom would consult on this matter at the time.

8.2.13 There may also be specific policy considerations which arise during the phased introduction of trading. It is important to ensure that the transition to tradability and liberalisation does not create undue uncertainty about the regulatory environment, particularly where large on-going investment programmes are based on the existing framework. For example, there may be proposals to change the use of other bands that could affect services such as broadcasting and 3G mobile. Ofcom would need to take its statutory duties into account in assessing any such proposals. Given the large scale and significant risks of the existing 3G investment programmes, Ofcom would not expect to allow other bands not presently designated for 3G to change their use to offer 3G services until the end of the transition to full liberalisation and tradability, in 2007.

Co-ordination and interference

8.2.14 The possibility of undue interference requires technical co-ordination between users. In some spectrum bands, the UK has a number of co-ordination agreements with its neighbours, such as the Republic of Ireland, France, the Netherlands and Belgium, to avoid harmful interference between users in different countries. Ofcom will permit changes of use only where, or to the extent that, issues of international co-ordination do not arise.

8.2.15 Similarly, co-ordination is required to limit interference between users within the UK. For example, fixed services are difficult to co-ordinate with neighbouring mobile services. In assessing proposed changes of use, it will be necessary to take account of co-ordination requirements, resulting in limitations on the sorts of change of use that may be permitted for some spectrum. Even where a request for a change of use is accepted, processes such as individual site clearance with the MoD, the CAA and/or other users in shared bands may still be necessary.

8.2.16 In many areas of the spectrum, the removal of restrictions will be complicated by the techniques which have been adopted, over many years, to ensure efficient use of the spectrum by sharing bands. For example, in wide area and on-site private business systems, users are interleaved in a complex manner – with frequency re-use and sharing of channels between users – to achieve greatest efficiency of use. In these cases it is necessary for changes of use and reconfiguration to be restricted, in order to maintain complementary patterns of use. However, spectrum may still be traded provided appropriate provisions are made to safeguard other users.

Question 17:

(a) Do you think liberalisation of spectrum use as proposed should be pursued as well as trading?

(b) Do you agree with the constraints on liberalisation outlined above?

8.3 Interference management

8.3.1 Ofcom will not permit trading or the amendment of WT Act licence conditions to result in an interference free-for-all. In general, Ofcom expects that existing restrictions on use or reconfiguration will be made as flexible as possible, but will not be removed completely. For each licence class, Ofcom

will issue policy guidance on the extent of reconfiguration or change of use that in principle would be permitted. Because of the constraints described in the previous section, every change of use or reconfiguration proposed by licensees will require Ofcom's prior consent. In such cases, Ofcom will review the proposed change to determine whether there is a risk of undue interference to other users, and review the proposals in accordance with the criteria set out in its guidance (discussed in the previous section).

8.3.2 The proposed regime will not restrict the current freedoms some licensees have to plan the use of their spectrum, for example in the deployment of cellular base stations.

8.3.3 Ofcom is proposing the following process for approving proposed changes of use and reconfiguration, whether or not a trade is involved:

8.3.4 **Step 1.** The licensee would decide what reconfiguration or change of use it wishes to effect, and confirm with Ofcom whether the proposed changes require an amendment to the existing terms of the relevant WT Act licence.

8.3.5 **Step 2.** Where a licence amendment is required, the licensee would submit a request for a licence variation along with a technical study of the proposed changes of configuration or use, and send these to Ofcom.

- The study would be required to demonstrate that the proposed change is consistent with the right that the licensee holds to use the spectrum for which it is proposed the new use will apply. For licensees whose transmission rights remained very tightly defined in terms of apparatus, this would involve demonstrating that the proposed new configuration would result in equivalence to their current emissions.
- The technical study would also need to demonstrate that the proposed change would not cause interference to other users in excess of their guidance levels of interference. In the case of shared bands, much more detail will be required than for exclusive bands. As described in Section 7.4, applicants may request additional information from Ofcom in order to carry out this study.
- Ofcom will specify the type of information to be provided and require the study to be of a specified standard, so that it can make the necessary technical assessment of the proposals.
- Where the proposal is to reconfigure licences, the technical study would need to provide details of the scope of the new licence(s) requested.

8.3.6 **Step 3.** Ofcom would then assess the application for a change of use or reconfiguration, based on the assessment provided by the applicant. Ofcom will consider each application on its facts, in accordance with its statutory duties, taking account of any applicable guidelines it has issued.

- Although Ofcom is under no obligation to do so under the WT Act, Ofcom may notify neighbouring licensees (for example co-channel users, adjacent channel users or co-located users), and in some cases other parties who may be affected by the proposed change. They will have an opportunity to make representations to Ofcom if necessary.
- Ofcom will ensure that the proposed change conforms to international co-ordination agreements, harmonisation arrangements and treaty obligations.
- Ofcom may request further modelling and propagation studies or field monitoring, as required.
- Ofcom will consider whether there is any other objective justification on the facts to withhold its consent.

8.3.7 **Step 4.** Ofcom would then give its decision in writing to the licensee. In some cases Ofcom's approval may be subject to individual site clearance procedures, consultations with end users, or other stipulations. The circumstances in which Ofcom might refuse an application include:

- where the technical study is not up to the required standard or does not demonstrate the required technical parameters;
- directions given by Secretary of State which Ofcom is legally obliged to comply with;
- where Ofcom is not satisfied that non-spectrum related licence conditions (such as roll-out obligations) would be fulfiled as a result of the change (as discussed in Section 6.8); and
- in some circumstances, where in the light of statutory duties and public policy objectives, Ofcom considers that there are objectively justified grounds for refusing the request. A number of specific public policy considerations are discussed in Section 8.2.

8.3.8 **Step 5a.** Where Ofcom were to grant the requested amendment, Ofcom will update the Spectrum Registry, the UK Plan for Frequency Authorisation, and (if appropriate) the international registry of frequency assignments. Ofcom will provide appropriate new licence documentation to the licensee(s), and withdraw or amend the previous licence.

8.3.9 **Step 5b.** Alternatively, where the amendment is not granted, Ofcom will make clear the grounds on which it has refused the request, so that the licensee can modify its plans and make an alternative application if it wishes. In addition, it is proposed that licence holders should generally have an opportunity to make representations to Ofcom regarding its proposed decision to refuse the request.

8.3.10 Although Ofcom will evaluate proposals for changes of use or reconfiguration of licences, ultimate responsibility for avoidance of undue interference will remain with the licence holder. In effect, although Ofcom will endeavour to refuse approvals where technical assessments are demonstrably inaccurate, the party holding or acquiring the WT Act licence will need to satisfy itself of the accuracy of its assessment of the interference implications of its proposed change of use.

8.3.11 In the event of undue interference resulting from a change of use, the user initiating a change of use could be required to amend their transmission characteristics if a dispute is referred to Ofcom.

8.3.12 Ofcom recognises that it is important for the fluidity of the spectrum market that it is able to make these assessments of proposed changes of use rapidly. Ofcom will be designing its procedures for making these assessments and will consider making commitments to performance targets for the time taken to approve proposals for change of use.

8.3.13 These procedures would be very burdensome for small licensees, for example for a taxi company wishing to reconfigure a private business radio licence. For these volume classes, Ofcom proposes to amend the implementation of its MASTS programme (described in Section 9.5), to allow requests for changes of use to be submitted, and approval given, electronically.

Question 18:

(a) Do you agree with the proposed process for approval of licence reconfigurations or changes of use?

(b) Are there any other factors which Ofcom should take into account in whether or not to approve an application for a change of use?

(c) Should Ofcom make commitments to performance targets for assessing applications for change of use?

8.4 Investigations and dispute resolution

8.4.1 In recent years the volume of interference issues has risen due to increased congestion in the radio spectrum. Ofcom anticipates that this trend will continue, partly due to the emergence of technologies that lend themselves towards licence exempt use, the corresponding increase in activity in existing licence exempt bands, and the potential extension of exemption to some higher power services. It is possible that interference issues may also arise as a result of licensees changing the use of, or reconfiguring, their licences in the way that Ofcom is proposing should be permissible.

8.4.2 For these reasons, Ofcom will need to exercise increased vigilance in the monitoring of interference and resolution of related disputes, to ensure that the users of the radio spectrum continue to experience acceptable levels of service.

Interference investigations

8.4.3 Currently, the Radiocommunications Agency has certain powers to investigate cases where a user notifies it that the user is experiencing undue interference. Under the Communications Act, Ofcom will assume these powers from December 2003. In addition, Ofcom will be under a specific duty to provide advice and assistance to people complaining of interference.

8.4.4 Investigations may be initiated as a result of complaints by WT Act licensees, and may also follow as a result of Ofcom's monitoring activities. These investigations will seek to identify the source of interference and whether some form of remedial action is required. As described in Section 6.5, Ofcom is proposing to issue non-binding guidance which will help users determine the level of interference beyond which they may request Ofcom to investigate.

8.4.5 There are a number of possible sources of interference where remedies may be put in place without recourse to the dispute resolution procedure. These are:

- *Interference impacting safety of life services.* As the RA does now, Ofcom will act rapidly to counter undue interference affecting safety of life services.
- *Use of illegal equipment.* Where radio equipment is causing undue interference to a licensed user and the equipment is licence exempt or is transmitting outside of the parameters of its licence conditions or exemption conditions, or is completely unlicensed where a licence is required, this will remain a criminal offence. It will be dealt with in a proportionate manner through Ofcom's enforcement powers for illegal transmissions. Penalties for illegal transmissions include warnings, fines, forfeiture of equipment and up to six months imprisonment.
- *Accidental interference and equipment faults.* The penalties set out above may also apply in such cases. However, warnings and Conformity Notices have generally provided satisfactory solutions to the vast majority of these types of problem in the past. Ofcom proposes to retain these measures. As now, Ofcom will charge a fee to complainants if the fault is found to be within their own equipment. If the problem is severe or intractable, then Ofcom would have to exercise tougher sanctions such as immediate close down and/or prosecution. If an aggrieved

party wished to invoke the more formal dispute resolution procedures, it could do so. However, where a prosecution is underway, the courts may order the disputes procedure to be stayed pending the outcome of proceedings.

- *Cross-border interference*. The UK has a number of bilateral agreements with neighbouring countries. Regular bilateral meetings with these countries provide a mechanism for raising specific interference difficulties. Ofcom will continue to use these arrangements to resolve disputes relating to cross-border interference.
- *Government systems*. In some cases the sources of interference are government systems, including those of the Ministry of Defence. Ofcom will endeavour to resolve these, as the RA does now. These systems fall outside the scope of the new legislative procedures in the Communications Act for investigating disputes. Particular difficulties involving these systems will continue to be resolved through established inter-governmental arrangements organised under the Cabinet Office committee responsible for spectrum issues.

8.4.6 Undue interference may also arise as a result of reconfiguration or changes of use by a licensee. As described above, licensees who propose to reconfigure or change the use of their licences must first provide Ofcom with a report demonstrating that the new use will not result in interference to other users above their guideline levels of interference. If the equipment in practice results in a higher level of emissions than specified in the licensee's spectrum licence, or breaches the guideline rate of interference of others, Ofcom will generally require the licensee to alter their transmissions such that interference with other licensees drops below undue levels, and may seek to vary the terms of the licence accordingly.

Dispute resolution

8.4.7 At present the RA manages the spectrum actively to avoid undue interference between users, and tends to approach interference disputes through a process of negotiation and mediation between parties, as well as ensuring that licence conditions are adhered to. Ofcom anticipates that under spectrum trading, most disputes about interference will continue to be resolved quickly in this way, without the need to invoke Ofcom's formal dispute resolution procedures.

8.4.8 However, there may be certain cases where parties have not been able to reach agreement in this way, or where commercial issues around a trade involve a dispute about obligations related to management of the radio spectrum. In these cases one or both users may refer the matter to Ofcom's dispute resolution procedures.

8.4.9 Interference disputes may also arise as a result of incompatible initial conditions. As discussed in Section 6.4, Ofcom is proposing to redefine the emissions right for some licences in terms of transmitted power and a spectrum mask. Each licence class will also have a guideline level of interference above which Ofcom may be requested to investigate and which may trigger dispute resolution proceedings. Ofcom will carry out appropriate propagation modelling in calculating these new conditions. However, in-the-field interference levels may in reality exceed predicted interference. Therefore transmission by one licensee, even within the new terms of their licence, may result in another licensee experiencing interference above their guideline levels. In this circumstance Ofcom will require parties to seek to negotiate a proposed solution between themselves before referring a dispute to Ofcom. Ofcom may consider referring the dispute to an alternative dispute resolution process or act to resolve the

dispute should the dispute be referred back to it by the parties.

8.4.10 Just as Oftel and the RA[10] are currently required to meet the timetable for dispute resolution set out in chapter three of the Communications Act (apart from in exceptional circumstances), Ofcom will be required to resolve disputes in the shortest possible time, and in any case, within four months. In the case where a formal submission for a resolution is made, Ofcom is proposing a six-stage approach to dispute resolution, similar to Oftel and the RA's current dispute resolution procedures. The six stages are:

- *Submission of request for dispute resolution to Ofcom.* Ofcom will consider within 15 days whether the submission is adequate, and whether or not it is appropriate for Ofcom to deal with the dispute, or whether there are more appropriate alternatives (such as further negotiation or mediation).
- *Ofcom will publish high level details of the dispute on its website* – including a summary of issues in dispute and the procedures to be followed to resolve the dispute. This will allow other affected parties an opportunity to respond or submit additional complaints.
- *Ofcom will undertake necessary investigations,* including submitting any necessary information requests to the parties involved. Ofcom will generally expect to allow five days for comments and questions regarding the content and deadlines of information requests.
- *Ofcom may consult on its decision,* if changes to arrangements are proposed that could potentially affect other spectrum users. Ofcom may hold a public consultation. This public consultation will generally be for a period of ten days.
- *Ofcom will adjudicate* based on the best information it has available on or before the target completion date.
- *Ofcom will always publish its final decision.*

8.4.11 Further details of Ofcom's proposed dispute resolution scheme, including the minimum contents of a formal request for dispute resolution, may be the subject of a separate consultation.

8.4.12 Ofcom will generally not have the statutory power to become involved in commercial disputes around spectrum trading where such disputes are unrelated to the management of the radio spectrum. If the dispute does involve regulatory provisions relating to the management of the radio spectrum (e.g. application of the Trading Regulations or rights or obligations under WT Act licences), then Ofcom may have a role in its resolution. Involvement in other commercial or contractual issues is beyond Ofcom's statutory powers, and the parties would instead have to apply to the courts.

8.4.13 In resolving a dispute relating to spectrum management issues, Ofcom's main power will be to make a declaration setting out the rights and obligations of the parties to the dispute. However, Ofcom will also have the certain powers to vary, modify or revoke WT Act licences or grants of RSA following a dispute.

8.4.14 The Communications Act gives Ofcom the right to charge for resolving disputes in relation to spectrum management. In order to discourage frivolous disputes, Ofcom is considering charging a cost-oriented fee to the initiator of the dispute. Ofcom is mindful that it is essential that the cost of dispute resolution is not prohibitive, particularly to small licensees, and that the costs of possible subsequent dispute procedures do not provide a disincentive to trade. Ofcom expects to consult

10. Since July 2003

further on dispute resolution procedures, including on any fees charged.

Question 19:

(a) What types of disputes do you envisage arising as a result of spectrum trading and licence liberalisation?

(b) Beyond its statutory duties on disputes, how far should Ofcom become involved?

8.5 Ensuring effective competition

8.5.1 Under the EU Framework Directive, Ofcom has a duty to ensure that competition is not distorted as a result of any spectrum trade. Ofcom's trading regime will have to ensure, therefore, that this requirement is met.

8.5.2 As discussed in Section 4, the introduction of spectrum trading should help promote effective competition in the markets in which spectrum is used and therefore reduce the possibility of distortion of competition. This is especially the case where change of use is possible across a broad range of different bands. But until trading and changes of use becomes more established Ofcom considers that there is the potential for individual trades to distort competition.

8.5.3 By allowing companies to purchase more spectrum, trading could lead to the acquisition of market power both in the market for a particular type of spectrum, and in a related downstream market (i.e. a market, like cellular telephony, to which spectrum is an input). Such market power could then be used in ways which distort competition. For example:

- Companies may limit competition in downstream markets by purchasing spectrum and then preventing competitors from accessing it.
- Companies may obtain control of a large proportion of the spectrum necessary for a particular service. They could then seek to prevent competition in other related markets by requiring customers to purchase access to the spectrum along with another product (such as transmission equipment).
- Intermediaries such as spectrum management organisations may be able to charge excessive prices for access to the spectrum that they control. Users may be forced to pay the excessive prices because their transmission equipment works only on those frequencies.

8.5.4 One way for Ofcom to prevent such anti-competitive behaviour is to rely exclusively on the provisions of the Competition Act[11] which prohibit certain types of conduct which are considered to be an abuse of a dominant market position. However, these provisions only apply once a dominant market position already exists, and they cannot be applied to prevent a company acquiring a dominant market position in the first place. The provisions of the Competition Act[12] which prohibit certain types of agreements that restrict or distort competition are likely only to apply to certain categories of spectrum trades.

8.5.5 The nature of the radio spectrum is such that it may present particular challenges for the application of competition law. For example, it may be very difficult to identify excessive pricing practices in spectrum, as there are no inherent costs of holding spectrum, apart from the administrative incentive price. It may also be very difficult to distinguish between commercial uses of spectrum and anti-competitive hoarding of spectrum, owing to the complexity of identifying inefficient technical use of spectrum, and the difficulty in making judgements about whether a particular application might be able to use spectrum more efficiently at a different frequency. It may also be very difficult to determine

11. Specifically the Chapter II provision which prevents abuse of a dominant position
12 Specifically Chapter I

appropriate remedies to these kinds of anti-competitive behaviour.

8.5.6 For these reasons, Ofcom considers that it is desirable to address the acquisition of market power as well as the abuse of dominance. This is especially (but not exclusively) relevant in markets where Ofcom has specific duties to promote competition, i.e. in the markets for electronic communications networks and services, and facilities associated with those and the broadcasting markets.

8.5.7 In most markets, the Enterprise Act 2002 is used to control the acquisition of market power. In broad terms, it only applies to transactions if they meet the following criteria:

- Two or more enterprises must cease to be distinct, i.e. they must be brought under common ownership or control.
- The transaction must not yet have taken place, or must have taken place within the previous four months.
- The UK turnover associated with the enterprise which is being acquired must exceed £70 million, or the enterprises concerned must supply or buy at least 25 per cent of a particular product in the UK or a substantial part of it.

8.5.8 The definition of 'enterprise' is broad and can include the sale of intangible assets such as rights to use spectrum. The relevant OFT guidelines [13] state that 'intangible assets' such as intellectual property rights are unlikely, on their own, to constitute an 'enterprise' unless it is possible to identify turnover directly related to the transferred intangible assets that will also transfer to the buyer.' Some types of spectrum trade might therefore qualify. In particular, these may include trades where a positive obligation to supply (such as a roll-out obligation) is sold along with the spectrum, or other trades where revenue is otherwise attached to the spectrum. The merger provisions of the Enterprise Act may apply to these types of trade, and so they may be examined by the OFT.

8.5.9 However, those trades which involve only the sale of rights to use spectrum, and do not have revenue attached to the spectrum, are unlikely to fall under the remit of the Enterprise Act.

8.5.10 Therefore, both the Competition Act and the Enterprise Act may be applied to some of the anti-competitive practices that may arise from spectrum trading. However, Ofcom considers that it would also be important to address the issue of market power acquired through owning rights to use spectrum by means of a specific set of rules on spectrum trading.

8.5.11 This will be done in a way which carefully analyses potential competition concerns. It will involve the definition of the relevant markets, the assessment of actual and prospective market power within those markets, and the appropriateness of potential remedies.

8.5.12 The proposed set of spectrum acquisition rules will be similar to the existing rules for mergers of enterprises. This approach will have the benefit of using a well established set of rules, with which many organisations are familiar. Ofcom's competition review would take place as part of its approval process for spectrum trades. As in the case of mergers, parties to a trade could request Ofcom to carry out an investigation into a proposed trade before a transaction took place.

8.5.13 In assessing whether or not a particular trade of spectrum should be scrutinised for competition concerns, Ofcom proposes to apply a share of supply test similar to that set out in the Enterprise Act 2002. In scrutinising trades, Ofcom's tests

13. *Mergers – substantive assessment guidance, OFT*

would be similar to those applied by the Office of Fair Trading (OFT) and the Competition Commission in judging whether to approve mergers of enterprises. Ofcom's tests would therefore assess whether a trade of spectrum might be expected to result, in a substantial lessening of competition within any market in the UK.

8.5.14 Ofcom does not intend to apply mechanistic limits to the amount of spectrum which can be held by an operator (so-called 'spectrum caps'), since these have the inherent weakness of failing to consider the level of market power. In particular, spectrum caps fail to take into account the fact that, in many cases, there are alternative ways of delivering the downstream service other than by using spectrum.

8.5.15 Ofcom understands the importance of providing certainty into the process it is proposing, the criteria it will use in deciding whether to investigate trades, and the criteria it will use in making its assessment. Once this current consultation has been completed, Ofcom will consult separately on the procedures and substantive assessment it proposes to apply in judging competition issues in spectrum trading. This separate consultation will cover, amongst others, the following issues:

- the threshold at which spectrum trades will be subject to consideration by Ofcom;
- the notification procedures required;
- whether those proposing to trade spectrum will be able to obtain informal guidance from Ofcom;
- a more detailed description of the criteria used for the substantive assessment;
- the time limits which Ofcom will apply in assessing trades; and
- how Ofcom and the OFT will liaise where a single transaction is to be considered under both the Enterprise Act and spectrum trading rules.

8.5.16 In the meantime, comments from respondents are invited on Ofcom's proposed approach to this issue and on the detailed processes involved.

8.5.17 Except where specific roll-out obligations are applied, Ofcom is not proposing to put in place 'use it or lose it' requirements. Ofcom believes that spectrum trading and administrative incentive pricing will provide sufficient incentive for licensees to use spectrum efficiently or sell it on, and will be a more effective incentive than legal 'use it or lose it provisions' which do not have an economic underpinning. However, there are two cases in particular where spectrum may be unused by licensees. First, market makers may emerge who hold a position in spectrum. These will perform a useful function by providing liquidity in the market. Second, licensees may try to hoard spectrum for anti-competitive motives, preventing competitors from accessing it. Ofcom's proposed measures to protect competition are designed to prevent such anti-competitive hoarding, while allowing such market making functions.

Question 20:

(a) Do you agree that an assessment of whether a spectrum trade can be expected to result in a substantial lessening of competition is appropriate?

(b) How should such a test be applied in practice?

8.6 Spectrum pricing

8.6.1 Ofcom is considering the application of administrative incentive pricing (AIP) to all WT Act licences, except auctioned spectrum where pricing arrangements were determined under the terms of the auction.

8.6.2 The Radiocommunications Agency has commissioned a Review of Spectrum Pricing, which is being undertaken by the consulting firms

Indepen and Aegis, and Warwick Business School. They are reviewing the methodologies by which prices are set and the licence classes to which AIP should apply. At a high level, the methodology suggests that administrative incentive prices should reflect the opportunity cost of holding spectrum, assessed by comparison with the least cost alternative technology at the margin. This study is anticipated to be published shortly. Ofcom expects to consult with stakeholders on future application of the pricing recommendations to radio licences.

8.6.3 Both spectrum trading and administrative incentive pricing have the intention of encouraging users to make efficient use of spectrum assignments. Therefore, there are arguments that once trading is well established, Ofcom may dispense with AIP. AIP is expensive to administer, as it requires regular reviews. Anticipated changes in the level of AIP create significant uncertainty in the market, which may act as a disincentive to trade. It is difficult to find the true opportunity cost of spectrum use, because it is based on a theoretical estimate of the value of spectrum. Therefore AIP has the potential to distort the efficient operation of a spectrum market.

8.6.4 However, there are also arguments that the two mechanisms are complementary, and the introduction of trading does not obviate the need for administrative incentive pricing. These arguments are listed below:

- Experience of other spectrum markets, in particular those of Australia and New Zealand, indicates a relatively thin market for some classes of spectrum, at least initially. In these cases trading alone is unlikely to be sufficient to ensure greatest efficiency of spectrum use.
- Without AIP, there may be little or no economic cost of holding spectrum if the value of the spectrum asset is appreciating. Holders may also attach a high option value to retaining their spectrum assets even if they are currently not using them. In such cases, trading alone would not be a sufficient incentive for efficiency.
- There may be holders of spectrum, particularly large organisations, whose financial objectives are determined in terms of cash costs rather than the opportunity cost of failing to sell their assets.
- Administrative incentive pricing can be used to reflect social values of spectrum not captured in private trading. One aspect of this is that an abolition of pricing is likely to lead to significant windfall.
- The economic cost of setting administrative pricing too high exceeds that of setting it too low. Regulators have tended deliberately to err on the low side when setting administrative incentive prices, reducing the potential efficiency of spectrum allocation which could be achieved through pricing. Trading and pricing are complementary, since even if prices are set too low, spectrum users can trade to a privately efficient outcome.
- Whereas administrative incentive pricing should capture the opportunity cost of marginal spectrum, the trading value would represent the additional scarcity value or economic rent associated with whole blocks of spectrum. The combination of preset administrative incentive pricing and capital values expressed in trading would equate to the overall market value of spectrum.

8.6.5 For these reasons, Ofcom believes that AIP and spectrum trading should be used in parallel. However, some aspects of administrative incentive pricing will need to change as a result of the introduction of spectrum trading. Purchasers of rights to use spectrum will need to have some degree of certainty as to the future of fees relating to that spectrum, the timing of pricing reviews and the protocols for reviewing the level of AIP.

8.6.6 Consequently, Ofcom intends to make clear the timescale of future reviews of administrative incentive pricing, and the outline methodology that will be used. The review period is likely to be every five years and, although the precise details of the methodology to be employed would be determined at the time of the review, it is proposed that pricing reviews would continue to reflect the opportunity cost of that spectrum, based on the least cost alternative technology at the margin.

8.6.7 Where the use of a licence is changed (for example, from a fixed to a mobile radio service) between these scheduled reviews, it is arguable that the administrative incentive price for the spectrum should change too, to the price charged for other blocks of spectrum in the new use. However, Ofcom does not propose to carry out one-off reassessments of pricing for licences upon change of use. Such an approach would rapidly become impractical in a much more fluid environment for spectrum use. In addition, it would be likely to increase uncertainty and act as a disincentive to trade. Instead, Ofcom proposes that administrative incentive prices should be fixed for particular blocks of spectrum for the duration of the pricing review period. They would remain constant between scheduled reviews even if the use of a particular band changed, i.e. the level of administrative pricing would change only at the time of the next scheduled pricing review.

Question 21:
In what ways do you anticipate that administrative incentive pricing will need to be changed to take account of spectrum trading?

8.7 Taxation of trades

8.7.1 The introduction of a market in the right to use spectrum may give rise to a set of new economic activities and gains. Services may include those of intermediaries in the trading process, such as those providing information and conveyancing. Gains may include both income from the leasing and hiring of spectrum, and capital gains from the sale of spectrum.

8.7.2 All of these activities, incomes and gains will subject to the tax regime in the normal way, including income tax, corporation tax, value added tax and other taxes as appropriate. It will be for the industry to consider and to seek appropriate advice on the application of the tax regime to gains from trading at the time of undertaking a trade.

Section 9

Trading Proposals by Licence Product

9.1 What this section covers

9.1.1 This section outlines Ofcom's proposals for the introduction of trading in each of eight licence classes. It provides a brief description of each licence class, the timing of introduction of trading, any constraints that Ofcom would in principle impose on changes of use and reconfiguration, and the principal proposed licence amendments that would be required for the introduction of trading. The licence classes are:

- broadcasting;
- programme-making and special events;
- public wireless networks;
- private business systems;
- fixed terrestrial and satellite links;
- maritime and aviation;
- science and technology, and licence exempt spectrum; and
- emergency services and the Ministry of Defence.

9.2 Broadcasting

Description of licence class

9.2.1 Terrestrial broadcasting consists of television and sound broadcasting (radio). Each has analogue and digital transmission technologies in use. Exhibit 7 summarises the current licensing arrangements.

9.2.2 Independent radio and television broadcasting share similarities in the way that they are licensed under the Broadcasting Acts. Sound and television broadcasters, or their chosen transmission providers, are granted also a corresponding WT Act licence to permit access to the spectrum they require to deliver the obligations enshrined in their Broadcasting Act licence. BBC services do not require a Broadcasting Act licence though their spectrum usage is licensed under the WT Act. For sound broadcasters, the WT Act licences are held either by the broadcasters themselves or one of a number of transmission providers. For the major TV services, the WT Act licences are held by NTL and Crown Castle who operate the transmission networks under contracts to the Broadcasting Act licensees and the BBC.

9.2.3 The Broadcasting Act licences are focused on content issues and, where applicable, reflect also wider positive public service obligations (e.g. concerning coverage requirements). WT Act licences confer the right to use spectrum on certain technical and other terms.

9.2.4 Dual licensing for independent broadcasting will continue, using the Broadcasting Act licences to describe and enforce positive obligations with respect to broadcasting, and the corresponding WT Act licence to specify and enforce obligations with regard to use of the radiofrequency spectrum.

9.2.5 Ofcom is awaiting the results of the Indepen study into Administrative Incentive Pricing. This study is looking at all aspects of administrative incentive pricing, including its future application to television and radio broadcast spectrum. Ofcom will consult separately on any proposals to extend administrative incentive pricing to broadcasting.

Trading approach

9.2.6 In principle, trading in broadcast spectrum is not complex, as there are relatively few licensees with significant spectrum assignments. However, the legacy of a centrally-planned, shared frequency approach, and the need to await detailed plans for switchover limit the scope for early introduction of trading. Exhibit 8 summarises the proposed approach to trading for broadcasting spectrum.

Exhibit 7: Terrestrial broadcasting: current licensing arrangements

Licence class	No. of licensees		Comments
Television broadcasting	Analogue	18[14]	• The five analogue channels and six digital multiplexes are interspersed across 46 x 8MHz channels between 470 and 854MHz. • The BBC, the ITC and the RA manage the detailed frequency planning/co-ordination of the broadcasting frequencies, assigning individual transmitter frequencies to transmission providers Crown Castle and NTL. These functions are to transfer to Ofcom. • Interference effects mean that the same frequency cannot be used nationwide to deliver an analogue service or a digital multiplex. Five or so channels out of an available 46 are re-used at each of the hundreds of transmitter sites around the country to produce nationwide coverage. There may be some opportunity to use some of the channels not used at particular locations ('interleaved spectrum') for other low power uses that do not interfere with television coverage. However, the need to plan for digital switchover means that the detailed future pattern of this 'interleaved' spectrum is not yet known. In particular, transitional arrangements for switchover are not yet decided, and any plan would be subject to international co-ordination agreements.
	Digital	6[15]	• Of the six DTT multiplexes, one is reserved for the BBC and five have been licensed under the Broadcasting Act 1996. Of these five: one is reserved for Channel 3 licensees, for Channel 4 and the Public Teletext Service; another is a commercial multiplex with capacity reserved for Channel 5; and three have been regranted, one to the BBC and two to Crown Castle. • There is a limit of 10 per cent on the proportion of capacity which may be used for non-programme-related services on all multiplexes • After digital switchover 14 channels will be released for re-use, as well as some interleaved spectrum.

14. Not including the BBC and Restricted Service Licence (RSL) licensees
15. Five licensed under the Broadcasting Act and one reserved for the BBC

Exhibit 7: Terrestrial broadcasting: current licensing arrangements

Licence class	No. of licensees		Comments
Sound broadcasting	Analogue	313	• Five national BBC-owned, three national commercial, 44 BBC local radio and 271 commercial local sound broadcasting licences. • Relatively limited bandwidth requirements – an FM Band II station requires a 270kHz channel to broadcast. • Detailed planning of frequencies is undertaken by the regulator to reflect its statutory responsibilities and to ensure efficient re-use of frequencies nationwide. • Spare capacity on the three national commercial channels is allocated by the Radio Authority through a competitive process, with local licensees and BBC able to sub-lease independently of this process.
	Digital	45	• Two national multiplexes (one owned by the BBC and one by Digital One, a joint venture between GWR and NTL) and 45 local multiplexes licensed to date under the Broadcasting Act 1996. • 7x1.5 MHz channels allocated to DAB between 217.5 and 230MHz – two channels assigned on a national basis to the national multiplex licensees with five channels available for local multiplexes. • There is a limit of 20 per cent on the proportion of capacity which may be used for non-programme-related services on any multiplex.

Exhibit 8: Terrestrial broadcasting: trading proposals

Licence class		Timing of Introduction	Comments
Television broadcasting	Analogue	Not before 2007	• Await greater clarity on frequency re-planning and future policy with regard to Public Sector Broadcasting (PSB) obligations and administrative incentive pricing before trading can be introduced • Spectrum trading will only be introduced where it does not delay or act as an impediment to the switchover process
	Digital	Not before 2007	• Similarly, await greater clarity on analogue frequency re-planning before trading can commence
Sound broadcasting	Analogue	End 2004	• Change of ownership of Broadcasting Act licences is already allowed, and transfer of associated WT Act licences is *de facto* automatic. • Owing to the need for complex central frequency planning to fulfil Broadcasting Act requirements, it is proposed that reconfiguration and change of use would not in principle be permitted
	Digital	End 2004	• Change of ownership in digital licences proposed to be permitted as at present • Some limited trading of interference protection rights between existing licensees within existing Broadcasting Act commitments to be introduced in 2004. • In the longer term, licences could be replaced on expiry with more flexible 'spectrum' licences.

Television broadcasting

9.2.7 At present, the use of the television broadcasting spectrum is subject to a high degree of flux given the introduction of digital TV among the analogue frequencies and moves towards digital TV switchover. The opportunities for trading are also limited as public service broadcasting and coverage obligations limit the possibility of change of use.

9.2.8 Consequently, Ofcom proposes to delay the consideration of trading in analogue and digital spectrum until frequency plans for switchover, including international frequency co-ordination issues, are clear. Ofcom anticipates this to be around 2007. At that point it is anticipated that Ofcom will be better able to define tradable rights and offer precise proposals regarding trading. It is possible that the imminent prospect of switchover may still reduce the potential for significant gains to be made by complex trading in analogue TV spectrum prior to switchover.

9.2.9 Therefore Ofcom will focus on the opportunities for trading after the detailed plans for digital switchover are more advanced. One option which would improve the flexibility of this spectrum would be to increase the ten per cent limit on multiplex capacity which may be used to provide non-programme related services. Ofcom will consider this option further in discussion with Government, bearing in mind any plans for digital switchover.

9.2.10 In the meantime, Ofcom will encourage television broadcasters to maximise the efficiency of use of spectrum in the television broadcasting bands, by permitting them to hire out capacity at the margins, e.g. access to broadcasting frequencies overnight, providing that such use does not result in undue interference to other users, nor place any constraints on the ability to of the analogue broadcasters to exit the spectrum.

9.2.11 Ofcom will also consider the scope, before switchover, of licensing some of the interleaved spectrum, i.e. the 35 out of 46 channels which cannot be used to broadcast analogue or digital services at any given transmitter location, due to co-ordination requirements with other transmitters. As the frequency plan for switchover develops, there may be some channels, within certain transmitter footprints, which may be assigned, possibly on a temporary basis, for low power non-broadcast applications. These assignments would be tradable and made on a non-interference, limited protection basis.

Radio broadcasting

9.2.12 In contrast to television broadcasting, there is no immediate prospect of digital switchover in audio broadcasting. The planning of the sound broadcasting spectrum is carefully ordered by the regulator in order to fulfil its statutory responsibilities in relation to broadcasting and to encourage efficient spatial reuse of the radio frequencies.

9.2.13 Broadcasting Act sound broadcasting licences are already transferable. In practice, transfer of associated WT Act licence has been automatic. However, in legal terms, WT Act sound broadcasting licences are not transferable. To simplify this situation, Ofcom proposes to make sound broadcasting WT Act licences tradable.

9.2.14 In December 2003 Ofcom will take on the role of principal in planning sound broadcasting services, replacing the Radio Authority. Ofcom will continue to assign rights to spare capacity on the national analogue stations, through competitive assignment. The level of planning involved in the analogue radio broadcasting spectrum is very high. Therefore, aside from introducing transferability of WT Act licences, Ofcom proposes to maintain the

current regime for assignment and management of analogue sound broadcasting spectrum. Change of use or reconfiguration of analogue licences would not in principle be permitted.

9.2.15 There is more scope for trading of digital sound broadcasting spectrum. There are currently seven digital radio channels. The smaller number of channels, and their lesser mutual dependence, has enabled a simpler plan to be devised for digital radio. There is also greater clarity attached to the constraints applying to licences.

9.2.16 Ofcom is proposing to issue guidance permitting in principle the limited reconfiguration of digital sound broadcasting WT Act licences. There are obligations contained within digital sound Broadcasting Act licences which set out required levels of coverage, and these would remain. However, it may be possible for licensees to meet these obligations without using all the spectrum rights implicit in the original Broadcasting Act advertisements. WT Act licences would be expanded in scope to describe more precisely the licensee's emission rights implied. In practice, this could allow some trading of interference rights between licensees without compromising the licensees' Broadcasting Act obligations. Ofcom is proposing to introduce such trading in 2004.

9.2.17 Digital Broadcasting Act licences also set out levels of service provision. As for television, one option which would increase the flexibility of the spectrum would be to relax the current 20 per cent limit on transmission of non-programme related services, while maintaining the positive obligations within the current Broadcasting Act licences. Ofcom may consider such relaxation as part of its review of digital radio.

9.2.18 The RA and Radio Authority are currently conducting a consultation on VHF and L-Band. One option under consideration is to make available new spectrum at L-Band, and potentially VHF, as general multiplexes. Issuing such general multiplex licences would give successful bidders full flexibility of use of the capacity and spectrum within the confines of the Eureka 147 technology.

Proposed licence amendments

9.2.19 At present, there is no clear linkage between the holding of a Broadcasting Act licence and the holding of a WT Act licence. In many instances, the holders are separate entities. It is proposed, therefore, as part of the consultation process on administrative incentive pricing in broadcasting, which will follow the results of the study by Indepen, Aegis and Warwick Business School, to clarify the licence holding issues. One possibility is to require the broadcaster, including the BBC, to hold the WT Act licence, either singly or jointly with their chosen transmission provider. This would create a 'one to one' link between a Broadcasting Act licence or BBC service and a WT Act licence, which may be an important facilitator for trading. This would also clarify the transfer the ownership and obligations for the WT Act licence when Broadcasting Act licences change hands.

Question 22:
Do you agree with the proposals for application of spectrum trading to television and radio broadcasting spectrum?

9.3 Programme-making and special events

Description of licence class

9.3.1 The programme-making and special events category encompasses the use made of the spectrum by broadcasters, independent producers, news gatherers, theatres, concert venues etc. for radio-microphones, radio-cameras, links to studios and transmitters etc. JFMG Ltd, a company owned by the ITV network and the CRCA, is subcontracted by the RA to manage the assignment and licensing of the spectrum to programme-makers and organisers of special events.

9.3.2 JFMG uses spectrum from Band I to 48 GHz, including interleaved television broadcasting spectrum, for licensing a range of mobile and (largely temporary) fixed link operations. With the assistance of the RA, JFMG supplements this dedicated programme-making spectrum with spectrum sourced from other users at times of high demand, e.g. for special events such as the Commonwealth Games and British Formula One Grand Prix.

Trading approach

9.3.3 No changes to the treatment of programme-making spectrum are envisaged before the expiry of the current contract between the RA and JFMG. However, Ofcom feels that the current contractual approach to the management of spectrum in this area may not be sustainable in a widely traded spectrum environment.

9.3.4 Subject to the outcome of this consultation, Ofcom will analyse the potential impact of trading on programme-making, and consult further with the interested parties. One option is to identify a viable amount of spectrum that could be assigned for programme making, possibly on a shared basis with other users. This could be assigned through a competitive process some time after 2005. The successful bidders would be free to provide access to the spectrum for all programme-makers at prices determined by the market and may also be permitted to offer spectrum to other users, e.g. hiring frequencies for PBR use.

9.3.5 It is anticipated that the programme-making licensees would also operate in the secondary market, buying and leasing spectrum from primary rights holders to supplement their primary assignments in support of their clients' requirements. In practice, the range of relevant spectrum may be limited initially, dependent on the availability of frequency agile equipment to use the spectrum.

9.3.6 This approach represents a fundamental shift in spectrum management for the programme-making spectrum, and has risks. However, Ofcom believes that such a model would represent an improvement on the current situation for a number of reasons:

- Continuing to offer spectrum access on a regulated cost-oriented basis would effectively act as a distortion in a competitive spectrum market – potentially degrading the commercial opportunity for other parties to emerge as resellers of spectrum.
- The ability of a spectrum management organisation to hold spectrum would confer greater surety of continued access to spectrum by the programme-making community. At the moment, spectrum holdings in this area cannot be assured over a longer term and may act as a disincentive to investment in new, including more spectrally efficient, equipment.
- There are numerous occasions when the dedicated programme-making spectrum is not

sufficient to cover the needs of an event (e.g. the Grand Prix and the recent Commonwealth Games) and the RA currently brokers the 'borrowing' of spectrum from other users to meet the demand. In a trading environment, the 'lending' licensees would expect to negotiate such activity on a commercial basis.

9.3.7 Ofcom is concerned by the risk of potentially anti-competitive behaviour by commercially focused spectrum management organisations, for example by denying access to smaller production companies and 'one-man' sound and camera operators, or by excessive pricing, where spectrum owners exploit quasi-monopoly positions. In addition, Ofcom is concerned that small users should continue to have access to this spectrum and that it is not bought up wholesale by larger users. As is discussed in Section 8.5, Ofcom will not only concern itself with abuses of dominance under the Competition Act, but will seek to counter any potential substantial lessening of competition that could result through trading, in order to limit the likelihood of such anti-competitive activity.

9.3.8 Ofcom proposes to investigate carefully the timing of introduction and the number of spectrum management organisations that should be accommodated in this manner, in order to balance structural and competition issues against the amount of spectrum likely to be available and the extent of trading possible at the time in other relevant frequency bands. Programme-makers make extensive use of PBR and fixed link frequencies, and therefore tradability can only be introduced in programme-making spectrum once trading has also been introduced in those bands.

9.3.9 In principle, Ofcom would prefer to counter anti-competitive behaviour through provision for multiple competitive providers of programme-making spectrum, rather than relying on additional regulation. Two or more competitive providers would offer programme-makers a choice of suppliers, and minimise the degree of explicit regulation of price and access which would be necessary with a single supplier. However, splitting the spectrum resource in this manner could reduce the overall technical efficiency of spectrum use, and may make the effective rationing of the spectrum resource among users, especially at congested special events, more difficult.

Proposed licence amendments

9.3.10 Ofcom will need to consider further proposals for structuring licences issued through a competitive process in this manner. It is possible that the successful bidder(s) for the programme-making spectrum will receive WT Act licences which set out the spectrum being made available and the technical terms of its use, to ensure adequate protection for the services with which the spectrum is shared.

9.3.11 As programme-making and special event use is by its nature highly fluid and requires dynamic management of the spectrum to accommodate different uses and configurations of the spectrum, it would not be practical for a spectrum provider to apply to Ofcom with every proposal for a change of use or reconfiguration of its spectrum. It is proposed, therefore, that they would be able to apply to Ofcom for an overlay right to change the use of any spectrum they obtain within a defined set of uses.

9.3.12 It is anticipated that the process by which the licensee makes its allocation of spectrum available to programme-makers would be on a hire basis. Arrangements may have to be made to deal with events where there is a particular concentration of spectrum use by a range of programme-making, emergency services, PBR and fixed link/satellite

options, such as Wimbledon or the Grand Prix. This would be necessary to ensure use by all parties with acceptable levels of interference, especially as the SMO and its hirers may require greater assurances about the quality of spectrum and levels of interference than do other users.

Question 23:
Do you agree with the proposals for programme-making and special events spectrum?

9.4 Public wireless networks

Description of licence class

9.4.1 Public wireless networks include six categories of radio networks operated by service providers offering radio services to third party consumer or business customers. The table in Exhibit 9 provides a more detailed outline of the licence products included in the public wireless category.

Trading approach

9.4.2 The limited volume of high value licences in the public wireless category means that there is likely to be considerable benefit from introducing trading to this licence class, and the level of administrative effort in doing so will be relatively low.

9.4.3 Therefore, it is proposed that change of ownership be permitted as soon as possible. Ofcom proposes to introduce trading in analogue PAMR, national paging, fixed wireless access and data network categories in the first wave of trading, commencing at the end of 2004. Trading in as yet unassigned categories – namely, 10GHz, and 40GHz bands would commence at the end of 2004, or upon issue, whichever is later. Trading in mobile satellite RSA would be possible once RSA have been introduced and tradability has been extended to them.

9.4.4 Ofcom proposes to delay trading in digital PAMR (TETRA), until band consolidation has been completed, anticipated by the end 2005. Once this process is complete, Ofcom proposes to introduce tradability as soon as possible.

9.4.5 Ofcom believes it to be desirable to introduce trading in 2G and 3G spectrum simultaneously, in order to prevent distortions in the cellular telephony industry. Ofcom believes that it would not be appropriate to introduce trading in cellular spectrum until issues relating to the future re-farming of 2G spectrum and identification of potential 3G expansion bands have been resolved, internationally and within the EU. The timing on both these decisions is subject to international harmonisation and agreement with the EU. For these reasons, Ofcom proposes that trading in cellular licences should not commence before end 2007.

9.4.6 Exhibit 10 summarises Ofcom's trading proposals, and the extent of reconfiguration and change of use that Ofcom proposes would in principle be permissible.

9.4.7 Ofcom proposes that guidance on the reconfiguration and change of use that would in principle be permissible would be issued simultaneously with the introduction of trading.

9.4.8 As the licences in this category are exclusive geographic licences for which boundary conditions can be easily defined, it is proposed that reconfiguration be permitted in principle for all licence categories except mobile satellite, subject to approval by Ofcom.

9.4.9 In some cases international co-ordination or harmonisation requirements constrain use – i.e. for digital PAMR (TETRA), GSM and UMTS

Exhibit 9: Public wireless networks: current licensing arrangements

Licence class		No. of licensees	Harmonised?	Comments
Cellular networks	GSM	4	Yes	• 2G mobile frequencies awarded through beauty contests
	UMTS	5	Yes	• 20 year 3G mobile licences awarded through auction in 2000[16]
PAMR	Digital	1 + 1 Nationally	Yes	• Inquam are licensed for the Dolphin PAMR TETRA system using 2x4MHz in the 400MHz band • Inquam are also licensed to implement a future TETRA2 overlay network in the 900MHz band
	Analogue	5 regional	No	• use MPT1327 trunking standard • Consultation on future requirements for analogue PAMR spectrum is ongoing • Unpaired spectrum for national paging
National paging		3	No	• Limited and falling numbers of users • One paging system for road traffic informatics
		1		• Regional licences recently auctioned – each valid for five years with an option to extend for two further five-year periods
Fixed wireless access	3.4GHz	15	No	• Consultation to be held in late 2003 on possibility of further licences being awarded
	3.6GHz	-	No	• Preliminary indications from the RA, (i.e. Q&A and information memoranda) indicate that mobile services should not be permitted
	10GHz	1	No	• To be auctioned before end 2005
	28GHz	15	No	• Regional licences auctioned in November 2000 • Further small area licences being considered
	40GHz	-	No	• To be considered for auctioning before end 2005
Data networks	Generic data networks	3	No	• Multiple-channel services using proprietary equipment for a variety of services including, e.g. - credit card swipe authorisations - cash ATMs at remote locations - telemetry and telecommand for vehicles (such as cash-in-transit applications).
	Asset tracking	1	Not at present	• Spread spectrum system covering 2MHz of the 800MHz band • A potential European asset tracking standard may be developed in the next two years
	AVL	1	No	• single channel currently licensed for AVL
	Remote meter reading	3	No	• 200kHz, low bandwidth proprietary systems • one national and two regional licensees
Mobile satellite		-	Yes	• Licence exempt – with RSA currently under consideration • Requires international co-ordination

16. With two year initial cushion to allow technology to develop. The current licences expire on December 31 2021

Exhibit 10: Public wireless networks: trading, change of use and reconfiguration proposals

Licence class		Timing of introduction	Transfer of ownership?	Reconfig-uration?	Change of use?
Cellular networks	GSM	by end 2007	Yes	Yes	No – harmonised bands
	UMTS	by end 2007	Yes	Yes	No – harmonised bands
PAMR	Digital	end 2005	Yes	Yes	No – harmonised bands
	Analogue	end 2004	Yes	Yes	Yes
		end 2004	Yes	Yes	
National paging		end 2004	Yes	Yes	Yes
Fixed wireless access	3.4GHz	end 2004	Yes	Yes	Within fixed applications
	3.6GHz	end 2004	Yes	Yes	Within fixed applications
	10GHz	end 2004	Yes	Yes	Within fixed applications
	28GHz	from issue	Yes	Yes	Within fixed applications
	40GHz	end 2004	Yes	Yes	Within fixed applications
Data networks	Generic data networks	end 2004	Yes	Yes	Yes
	Asset tracking	end 2004	Yes	Yes	Yes – within constraints of possible future harmonisation
	AVL	end 2004	Yes	Yes	Yes
	Remote meter reading	After RSA introduced	After RSA introduced	No	Yes
Mobile satellite					No – international co-ordination required

Exhibit 11: Private business systems: current licensing arrangements

Licence class		No. of licensees	Exclusive or shared?	Comments
Private business radio	National and Regional PBR	69	Exclusive	• 12.5kHz channels allocated to private users
	Common base stations	350	Exclusive	• Combinations of individual PBR systems • Typical users are, for example, local authorities with around 100 users on 2/3 base stations
	On-site PBR	26,000	Exclusive within approx. 5km radius	• Site-specific licences used for airports and shopping centres etc. • Effectively small scale geographically exclusive licences
Wide area PBR	Speech and data	13,000	Shared	• MASTS (Mobile Assignment Technical System) is currently being developed by the RA to automate the management of shared PBR assignments
	Distress alarms	18	Shared	• Although technically a shared category, limited demand has enabled exclusive channels to be allocated
	One way paging and speech	340	Shared	• Uses shared frequencies in a similar manner to Wide area (speech and data)
	IR 2008	3	Shared	• The IR2008 standard permits data insertion into one of the eight timeslots in the two or four second PBR cycle
5.8GHz	Band C	-	Shared	• It is anticipated that 5.8GHz Band C will be licensed for mesh network CPE in late 2003 • Although each terminal is low powered, there are a number of exclusion zones, and the band is shared with satellite and other users. Therefore the RA registers individual terminals in this band.

mobile, mobile satellite and to some extent asset tracking categories. The extent of change of use that would be permitted in principle would be restricted by the terms of international harmonisation agreements. In addition, interference co-ordination needs require that permissible change of use for fixed wireless access services would be constrained in principle to uses within point-to-point and point-to-multipoint fixed services.

9.4.10 As discussed in Section 8.2, given the large scale and significant risks of the ongoing 3G investment programmes, Ofcom would not expect to allow other bands not presently designated for 3G to change their use to offer 3G services until the end of the transition to full liberalisation and tradability, in 2007.

Proposed licence amendments

9.4.11 Where necessary, Ofcom proposes to redefine transmission rights in terms of PFD masks and boundary field strength threshold levels or limits, as outlined in Section 6.4. These will need to be consistent with international agreements and regulations. Emission designations, except where required for notification and site clearance procedures, may be replaced with references to relevant Interface Requirements or normative standards.

9.4.12 In general, Ofcom would propose to amend the notice period contained in licences in accordance with Section 6.6. There may need to be certain exceptions to the general five year notice period.

Question 24:
Do you agree with the proposals for application of spectrum trading to public wireless networks? Specifically, do you agree with:

(a) the proposed timing of its introduction;
(b) the proposals for the extent of licence reconfiguration and change of use that would in principle be permissible, and;
(c) the proposals for amendment to licence conditions?

9.5 Private business systems

Description of licence class

9.5.1 Private business systems encompass radio systems for closed or 'private' user groups. They are used for a wide range of commercial and public service applications.

9.5.2 The private business system category includes significant volumes of small licensees, approximately 40,000 in total. The majority of these licences authorise use in shared bands – i.e. they are not exclusive rights to the use of a frequency in a given geographical area.

9.5.3 Exhibit 11 describes each of the relevant licence classes in terms of exclusive or shared access to spectrum and the number of users within each category.

9.5.4 Shared licences are interleaved together on the same frequencies, and in neighbouring geographies, according to patterns of use. Channels are shared between different complementary users with differing profiles of usage intensity across the day. In practice, rights to use and quality of service in these shared bands are characterised by the length of time taken to access a channel. The Mobile Assignment Technical System (MASTS) described in further

Exhibit 12: MASTS Mobile Assignment Technical System

MASTS

The Mobile Assignment Technical System (MASTS) is currently under development. MASTS is designed to provide a system that will enable online licensing of Land Mobile Radio (LMR) services by producing fast, reliable and accurate frequency assignments.

The current method of assignment for business radio services is based on a rudimentary (non-scientific), and inconsistent process which relies heavily on regional knowledge of the area concerned. MASTS, when making assignments, will take into consideration local terrain and clutter information, radio usage and associated traffic together with the Applicant's requested service area (the desired area of radio operation underpinned by an agreed Quality of Service (QoS)).

MASTS will assist technical evaluation of potential spectrum trades, in particular evaluation of the scope for reconfiguration, permitting greater customer understanding of the limitations or potential being offered by a particular right of use.

It is anticipated that MASTS will be available to the public in 2005.

detail in Exhibit 12, is currently being developed by the RA to automate the management of shared PBR assignments.

9.5.5 For many licensees, their contact with licensing procedures is organised and co-ordinated by equipment brokers who arrange for a licence to be supplied to accompany the equipment they sell or lease. As a result, for many licensees, their only relationship with the RA is that of receiving and paying an annual bill for licence fees.

9.5.6 Ofcom assumes that brokers would continue to be the conduit through which individual users would participate in spectrum trading, including utilisation of MASTS.

Trading proposals

9.5.7 Change of ownership already occurs regularly with the take-over of commercial entities licensed to use these frequencies.

9.5.8 Ofcom proposes that trading rights of use should be authorised from end 2004 for all geographically defined Private Business Radio categories and 5.8GHz Band C, and from 2005 for shared Wide Area PBR. The table in Exhibit 13 shows Ofcom's proposed timetable for the introduction of trading, and the degree of flexibility of use and configuration that it proposes to permit in principle.

9.5.9 The extent of reconfiguration and change of use that would in principle be permissible is dependent on whether the licence in question is an exclusive licence within a given geographical area, or whether the licence is shared.

Exhibit 13: Private business systems: trading, reconfiguration and change of use proposals

Licence class		Timing of introduction	Change of ownership?	Change of use and reconfiguration?
Private business radio	National and Regional PBR	end 2004	Yes	Yes, within land mobile category – i.e. change between application (e.g. change from taxi to courier use), technology or private and public use
	Common base stations	end 2004	Yes	Yes, within land mobile category
	On-site PBR	end 2004	Yes	Yes, within land mobile category
Wide area PBR	Speech and data	end 2005	Yes	Yes, within the constraints of MASTS
	Distress alarms	end 2005	Yes	Yes, within the constraints of MASTS
	One way paging and speech	end 2005	Yes	Yes, within the constraints of MASTS
	IR 2008	end 2005	Yes	No
5.8GHz Band C		end 2004	Yes	No

Exclusive licences

9.5.10 Where users have exclusive rights to use spectrum under their licence, Ofcom proposes that reconfiguration of that licence would in principle be permitted, along with changes of use within the land mobile categorisation. Changes of use outside the land mobile category (e.g. to broadcasting or point-to-point links) would result in serious complication of co-ordination and interference avoidance policies.

9.5.11 Specifically, Ofcom proposes that the following changes of use would in principle be permitted, subject to case-by-case approval by Ofcom:

- changes of end-user application – e.g. from a courier firm to a taxi company;
- changes between public and private applications; and
- changes of technology – e.g. to equivalent analogue, digital or IP-based systems.

9.5.12 Therefore, changes to uses outside the land mobile category, or which result in undue interference to other users, would not in principle be permitted. Reconfiguration of licences would also be permitted in principle so long as undue interference did not result to other users, and subject to Ofcom's case-by-case approval.

Shared licences

9.5.13 There are three categories of shared licence:

- IR 2008;
- 5.8GHz Band C; and
- Wide area PBR managed by MASTS.

9.5.14 IR2008 permits access to Wide Area PBR timeslots for the carriage of data. Changes of configuration or use are not possible independent of the broader parent system – therefore, Ofcom proposes that change of use and reconfiguration should not in principle be permitted in this licence class.

9.5.15 There is no scarcity to the 5.8GHz Band C, as there is no limit to the number of terminals that can be registered. However, licensing is currently necessary because a number of exclusion zones and the proximity of other users makes it essential for the RA to know the location of each terminal. In this context, trading will enable new suppliers of mesh radio services to transfer the customer premises equipment (CPE), registrations of existing customers. However, because these licences are highly constrained, changes in configuration and use would not in principle be permitted.

9.5.16 Ofcom proposes to permit in principle change of use and configuration for wide area PBR licences managed by MASTS, provided that that change of use will not result in significant degradation of the quality of service experienced by neighbouring users, and subject to approval by Ofcom.

9.5.17 In practice, the broker supplying the new equipment which requires change of use or configuration of the existing licence will enter the new usage characteristics into the publicly accessible MASTS interface. If it is deemed to be permitted, MASTS will then record these new characteristics within its database.

9.5.18 The precise technical conditions under which a proposed change of use or configuration would be permitted or refused will require further definition once the first phase of MASTS implementation (which will provide an internal tool for use by the RA) is complete.

9.5.19 Therefore, the timing of introduction of change of use and reconfiguration within the shared licence categories will depend on the readiness of MASTS. At present it is anticipated that MASTS will be

complete by the end of 2005, and therefore Ofcom proposes that change of use and reconfiguration would be permitted in principle by the end of that year.

Proposed licence amendments

9.5.20 In most cases, Ofcom does not propose to redefine the transmission rights of PBR licences in terms of PFD masks and boundary field strength threshold levels or limits, as outlined in Section 6.4. Instead, the right to transmit will continue to be defined as currently.

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9.5.21 Ofcom proposes to amend the notice period contained in PBR licences in accordance with Section 6.6. This may be implemented by revision of the Wireless Telegraphy General Licence Conditions booklet.

Question 25:
Do you agree with the proposals for application of spectrum trading to private business systems? Specifically, do you agree with:
(a) the proposed timing of its introduction;
(b) the proposals for the extent of licence reconfiguration and change of use that would in principle be permissible, and
(c) the proposals for amendment to licence conditions?

9.6 Fixed terrestrial and satellite links

Description of licence class

9.6.1 The fixed terrestrial and satellite links licence class encompasses a range of pure 'fixed' services – i.e. transmissions between fixed locations – including satellite and terrestrial services. Exhibit 14 describes the licence products within the fixed terrestrial and satellite link class.

9.6.2 With the exceptions of satellite services and 31GHz video surveillance point-to-multipoint services, Ofcom proposes that all licence products should be included in the first wave of trading by the end of 2004.

9.6.3 Exhibit 15 outlines the approach to trading that Ofcom is proposing, and the degree of reconfiguration and change of use approach which would in principle be permissible, for the fixed terrestrial and satellite links.

Satellite services

9.6.4 Space-to-earth transmissions are unlicensed. However, Ofcom is anticipating introducing recognised spectrum access (RSA) in these bands in the future. The introduction of recognised spectrum access, RSA, provides the pre-requisite tradable 'right' to the spectrum. Trading in these frequencies could potentially begin once RSAs have been introduced and tradability extended to them.

9.6.5 Ofcom does not propose to introduce trading in exclusive satellite bands as these are managed on an international basis. In addition, there are well-developed market mechanisms, such as the London satellite exchange and satellite capacity brokers, which deal in this capacity. Whilst the RA licenses these bands it does not make individual assignments which would underpin a secondary trading market.

9.6.6 Trading for satellite services in the shared bands will not be possible without the introduction of recognised spectrum access, RSA, in a similar manner to space-to-earth transmissions. Trading in satellite spectrum in the shared bands could therefore potentially commence following the introduction of RSAs, and once tradability has been extended to them.

Exhibit 14: Fixed terrestrial and satellite links: current licensing arrangements

Licence class		No. of licensees	Exclusive or shared?	Comments
Satellite	Space-to-earth transmissions	14,500 subscriber terminals	Shared and exclusive bands	• Space-to-earth transmissions are currently unlicensed. The introduction of recognised spectrum access, RSA, is currently under consideration • Like all other satellite spectrum, co-ordinated on an international basis
	Earth station licences	Permanent Earth Stations: 145 Transportable Earth Stations: 116 VSAT: 40	Shared and exclusive bands	• 323 permanent earth stations and 192 transportable earth stations • Some earth stations transmit on frequencies in bands shared with point-to-point fixed links, whereas some frequencies fall in exclusive satellite-only bands • Similarly, space-to-earth transmissions and uplink frequencies are co-ordinated on an international basis • Exclusive satellite bands are brokered through market mechanisms, such as the London satellite exchange and capacity brokers
Terrestrial services	Point-to-point links	370 (32,000 links)	Shared	• Point-to-point link assignments are made by RA, with licences being returned when links are no longer required • Bands are very actively managed - across frequencies to ensure valuable low frequency bands are preserved for long-distance links - to get most technically efficient use of the spectrum, e.g. mixing satellite and fixed services • There is severe congestion on certain trunk routes – with surrounding geographical areas relatively uncongested
	32GHz	-	Part exclusive, part shared	• One third of the 32GHz band is used by the RA for fixed point-to-point link assignments • Two thirds of the 32GHz band is currently vacant and potentially available for primary assignment
	31GHZ point-to-multipoint	80	Exclusive	• Spectrum is allocated to video surveillance applications used by local authorities – mandated by the Home Office • Assignments are currently managed by the single manufacturer of equipment for this band

Exhibit 14 (contd.): Fixed terrestrial and satellite links: current licensing arrangements

Licence class		No. of licensees	Exclusive or shared?	Comments
Terrestrial services	Scanning telemetry	66	Exclusive	• National channels are licensed to the utilities, with management subcontracted to the JRC in the case of gas and electricity, and CSS for water

Exhibit 15: Fixed terrestial and satellite links approach to trading, reconfiguration and change of use proposals

Licence class		Timing of Introduction	Change of ownership	Reconfig-uration?	Change of use?
Satellite	Space-to-earth transmissions	Once tradability of RSA introduced	Yes	Yes	• Yes - within the terms and conditions of the RSA
	Earth station licences – exclusive bands	n/a	No	No	• No – harmonised and co-ordinated on an international basis
	Earth station licences – shared bands	Once tradability of RSA introduced	Yes	Yes	• Yes – within the terms and conditions of the RSA
Terrestrial services	Point-to-point links	End 2004	Yes	Yes	• No – highly directional licences, with exacting quality of service requirements
	32GHz	End 2004	Yes	Yes	• Yes
	31GHz point-to-multipoint	To be reviewed	To be reviewed	n/a	• n/a
	Scanning telemetry	End 2004	Yes	Yes	• Yes – national exclusive channels

Terrestrial services

9.6.7 Ofcom proposes to extend tradability to the 31GHz video surveillance bands used by local authorities to fulfil their statutory duties to provide video surveillance. Ofcom recognises that in the short term, it is unlikely that licensees would choose to trade as they require the spectrum to meet their statutory obligations. However, in the long term trading could be beneficial as a means of encouraging potential transition to more spectrally efficient technologies – freeing up parts of these bands for other applications.

9.6.8 Ofcom is proposing to introduce trading in the as yet unconstrained 32GHz spectrum, which would be licensed as tradable spectrum from first issue, for scanning telemetry and point-to-point links.

9.6.9 Ofcom proposes that both reconfiguration and change of use be permitted in principle both for the as yet unassigned 32GHz spectrum and the scanning telemetry licences currently used by the utilities. This is because these are exclusive national licences without international harmonisation restrictions and for which boundary conditions can be relatively easily defined.

9.6.10 As most point-to-point links are in geographic areas with no frequency congestion and assignments are specifically tailored for each user, it is likely that there would be no demand for those links from alternative users. In this case, assignments would, as currently, be returned to Ofcom when they become redundant and payments of licences fees relating to these links would cease. However, secondary trading would be effective on the trunk routes where assignments are currently extremely congested. In this case, users of fixed links could trade amongst themselves, encouraging the release of redundant capacity and the adoption of more spectrally efficient equipment.

9.6.11 Ofcom proposes to make reconfiguration only, and not change of use, permissible in principle for point-to-point links. This is due to the highly directional nature of fixed link assignments and the vulnerability of 99.999 per cent quality of service on neighbouring links to interference. Reconfiguration could be a valuable tool in encouraging incumbent users to reduce their frequency occupation through investment in more spectrally efficient equipment.

Proposed licence amendments

9.6.12 No changes to licences are proposed with respect to satellite services in exclusive bands.

9.6.13 For fixed services, Ofcom proposes to redefine transmission rights in terms of PFD masks and boundary field strength threshold levels or limits, as outlined in Section 6.4. Co-ordination threshold levels or limits must be consistent with national and international agreements and regulations. Emission designations and quality of service planning criteria are generally required for assignment, notification and site clearance procedures. Reference to the relevant Interface Requirements or normative standards may also be required.

9.6.14 In general, Ofcom proposes to amend the notice period contained in licences in tradable licence classes in accordance with Section 6.6. There may need to be certain be some exceptions to the general five year notice period.

Question 26:
Do you agree with the proposals for application of spectrum trading to fixed terrestrial and satellite links? Specifically, do you agree with:

(a) the proposed timing of its introduction;
(b) the proposals for the extent of licence reconfiguration and change of use that would in principle be permissible; and
(c) the proposals for amendment to licence conditions?

9.7 Maritime and aviation

9.7.1 The introduction of trading into the maritime and aviation licence classes is complicated by the safety of life considerations of these applications and the necessary degree of international harmonisation which exists for many of these bands. In addition, certain aeronautical bands are used for national security and military uses.

9.7.2 In principle, Ofcom wishes to permit users holding dedicated frequencies the ability to trade, while maintaining their duties to safeguard safety of life. This would allow users to release surplus spectrum to the market, for example, spectrum used by ground-based radio navigation (e.g. radar) systems. However, Ofcom recognises that the introduction of more spectrally efficient approaches may require some time, and potentially even amendment of current international harmonisation practice.

9.7.3 The day-to-day processing of aeronautical and maritime licences, except those for maritime coastal systems, has been subcontracted by the RA. In the case of aeronautical licences, the CAA issues the licences, and for on-board maritime licences, the Radio Licensing Centre (RLC) fulfils these duties. The CAA has some joint responsibility for spectrum and frequency management for aeronautical frequencies. In addition, the CAA is responsible for equipment approvals to satisfy the WT Act and ANO (Air Navigation Organisation) approval requirements.

Description of licence class

9.7.4 There are three main uses for spectrum in the maritime and aviation category, described in Exhibit 16:

- maritime communications;
- aeronautical communications; and
- radio navigation (e.g. radar), in each of the maritime and aeronautical sectors.

9.7.5 Each category consists of on-board and ground-based systems (termed coastal, in the case of maritime). In general, ground-based systems have fixed assignments, and on-board systems will share frequencies – using transmitting equipment which the user then switches to find an available channel to communicate with the appropriate ground-station.

9.7.6 In common with other mobile systems, on-board systems do not require specific spectrum assignments due to the (typically) transitory nature of any interference and the need to access a variety of channels used by fixed coastal or ground-based systems.

9.7.7 For on-board maritime use, the vessel is licensed to use transmitting equipment. The licence lists the type and band of the equipment rather than the particular details of that equipment or the frequencies in use. In contrast, aircraft are licensed with specific details and bands of the equipment carried on-board.

Trading proposals

9.7.8 Ofcom's proposed approach to trading spectrum rights in the aviation and maritime licence categories are summarised in Exhibit 17.

Exhibit 16: Maritime and aviation: current licensing arrangements

Licence class		No. of licensees	Exclusive or shared?	Comments
Aeronautical communications	On-board[17]	8,850	Shared	• Users access a shared 'pool' of frequencies on which to communicate with an assigned ground-station frequency • Internationally harmonised range of frequencies required due to international nature of aviation
	Ground-based	2,160	Exclusive	• Individual assignments to avoid undue interference between neighbouring stations • Assignments are made in ranges specified by international harmonisation
Maritime communications	On-board[18]	64,500	Shared	• Users access a shared 'pool' of frequencies on which to communicate with an assigned ground-station frequency • Internationally harmonised channels
	Coastal	1,500	Exclusive	• Composed of international channels as well as some UK-specific channels for maritime business use • Individual assignments – may involve international co-ordination
Radionavigation (navigational aids)	On-board (nav-aids)	-	Shared	• Operate on frequencies determined by equipment • Internationally harmonised bands
	Ground	280	Exclusive channels for aeronautical Shared use of band for maritime	• Internationally harmonised bands • Well established technology, with some installations using equipment which has been operating for as much as 25 years • Possible that over time, more modern radar installations could achieve similar performance with a reduced spectrum requirement.

17. Includes fixed and transportable equipment
18. Includes fixed and transportable equipment

Exhibit 17: Aviation and maritime: trading, reconfiguration and change of use proposals

Licence class		Timing of introduction	Change of ownership?	Reconfiguration?	Change of use?
Aeronautical communications	On-board	n/a	No	No	No
	Ground-based	Agreement by end 2007[19]	Yes	Yes with Ofcom /CAA approval	Within constraints of harmonisation for aviation and with Ofcom / CAA approval
Maritime communications	On-board	n/a	No	No	No
	Coastal	Agreement by end 2007	Yes	Yes with MCA approval	Within constraints of harmonisation for maritime and with MCA approval
Radionavigation (navigational aids)	On-board (Nav-aids)	n/a	No	No	No
	Ground	Agreement between 2007 and 2009	Yes	Yes with regulator approval	Within constraints of harmonisation with regulator approval

19. Significant changes to international agreements may require up to seven years notice.

On-board

9.7.9 Pooled on-board licence categories have limited suitability for trading as there is no scarcity value associated with licences to these frequencies. An owner of a new boat need only apply to the Radiocommunications Agency for a licence and one will normally be granted. Additional users will, in principle, increase interference on the shared communications channels – however, this is a marginal effect in that, in general, users would move to a clearer channel.

9.7.10 Transferability of on-board licences would permit owners effectively to trade the remaining portion of the annual fee between them – however, given the relative level of annual fees and administrative charges to register a change of ownership, the benefits of doing so are minimal.

9.7.11 Although outside the scope of this consultation, it is worth noting that, given these characteristics, certain types of on-board systems may in future lend themselves to deregulation – in the form of exemption from individual licensing. Consideration of deregulation is at a very early stage. Ofcom will liaise with CAA and MCA in formulating any proposals. As in trading, consideration of deregulation will need to take account of the vital safety and international dimensions.

Ground-based

9.7.12 Trading could take place in assignments for ground stations, within the constraints of harmonisation, international obligations and safety of life considerations and with the agreement of the relevant regulator. Ofcom recognises that for many users there may be little apparent incentive to trade, as their use of the radio-frequency spectrum is necessary for safety of life purposes. In addition, due to co-ordination with other international users, the extent of any change of use may be restricted.

9.7.13 However, as a general principle Ofcom would seek to provide holders of spectrum assignments with the option to trade in future, if they wish and if it is possible within the constraints of international agreements and co-ordination. For example, if technology advances permit more spectrally efficient use of the spectrum, a licence holder may be allowed to release a portion of their assigned spectrum to the market. In the long term, radionavigation (including radar) might benefit from trading in this way. No licensee would be under any obligation to trade.

9.7.14 The Government's response to the Review of Radio Spectrum Management, published in late 2002, proposed that pricing in the fixed aviation and maritime assignments and radionavigation should be implemented within five to seven years. In parallel, Ofcom proposes that trading for spectrum assignments used for ground-based aviation and maritime communications could be agreed by 2007. For radionavigation it could commence between 2007 and 2009, with simultaneous liberalisation of spectrum use in these licence classes to permit reconfiguration and change of use consistent with interference considerations, international harmonisation, and agreements for aviation and maritime purposes.

9.7.15 Where changes to international agreements would be required, these require approximately seven years for agreement. The timetable for introduction of trading will need to reflect this lead time.

9.7.16 Owing to the safety of life role of the radio spectrum in both the aviation and maritime sectors, it is proposed that trading should proceed with the agreement of the relevant regulators. In

the aviation sector, change of ownership and *ex ante* technical scrutiny of potential changes of use by licensees (within the scope of international harmonisation and agreements) should be assessed by the CAA in conjunction with Ofcom. No changes are foreseen to the current arrangements for CAA's administration of day-to-day licensing and frequency assignments for ground-based systems. In the maritime sector, Ofcom will undertake the administration and assessment of requests to change use and reconfigure licences, in close consultation with the MCA where international channels are affected.

Proposed licence amendments

9.7.17 Where tradability is to be introduced, Ofcom proposes to redefine transmission rights in terms of PFD masks and boundary field strength threshold levels or limits, as outlined in Section 6.4. Co-ordination threshold levels or limits must be consistent with national and international agreements, regulations and international harmonisation measures [20] where necessary. Emission designations are generally required for notification and site clearance procedures. Where necessary, reference to the relevant Interface Requirements or normative standards may also be required.

9.7.18 In general, Ofcom would propose to amend the notice period contained in these licences in accordance with Section 6.6. There may need to be certain exceptions to the general five-year notice period.

Question 27:

Do you agree with the proposals for application of spectrum trading to maritime and aviation spectrum? Specifically, do you agree with:

(a) the proposed timing of its introduction;
(b) he proposals for the extent of licence reconfiguration and change of use that would in principle be permissible; and
(c) the proposals for amendment to licence conditions?

9.8 Science and technology, and licence exempt spectrum

Description of licence class

Test and development licences

9.8.1 Test and development (T&D) licences are currently issued by the RA on a temporary basis to a variety of customers, from entrepreneurs to universities and well-established companies. The licences are 'made to measure', and are allocated all over the radio spectrum on an *ad hoc* basis depending on the research and development requirements of the customer.

9.8.2 Users of temporary licences have no protection from interference, and licences are granted on a non-interference basis, so that if they cause interference to other users, they must cease transmitting immediately. The licences are granted on the understanding that they must not be used for operational purposes, and granting a test and development licence does not represent an expression of intent by the regulator to issue operational licences on that frequency.

9.8.3 The RA's Science and Technology Unit currently co-ordinates with licensed users of the spectrum to ensure that temporary use can be accommodated. Occasionally, requests to share are refused, often

20. e.g. ICAO SARPS: International Civil Aviation Organisation Standards and Recommended Practices, ITU, IMO regulations

because there is insufficient suitable spectrum for the T&D user.

Use for scientific purposes

9.8.4 Spectrum has been made available for scientific research purposes at a range of frequencies. Some users are dependent on particular frequencies (e.g. studying hydrogen lines), while others have more flexibility of frequency. These scientific purposes include:

- radioastronomy;
- meteorology;
- satellite uplink; and
- weather radar.

9.8.5 Much of this spectrum lies within shared bands and is carefully co-ordinated to allow reception of, or listening to signals (for example for radio astronomy) without particular definition of rights. The Particle Physics and Radio Astronomy Research Council (PPARC) pays an annual sum to the RA in respect of work that RA undertakes to protect these frequencies. It is proposed, in parallel to the introduction of administrative incentive pricing for science services, to introduce Recognised Spectrum Access (RSA) for radio astronomy services.

Licence exempt spectrum

9.8.6 Traditionally, licence exemption has been associated with low power short range privately operated devices. These include car key entry systems, domestic wireless alarms, garage door openers, model control and telemetry systems. Use of licence exempt spectrum has recently been growing rapidly driven particularly by the demand for wireless communication devices to support IT, for example Bluetooth and Wireless LANs.

9.8.7 Users of licence exempt equipment have no protection from interference, unless it results from third party illegal operation. The introduction of corporate Wireless LANs and public access Internet points, offering commercial services within the licence exempt bands, has been successful. To date congestion has not been a significant problem. Nevertheless, public telecommunication within licence exempt bands operates under the same technical constraints as private use and is not afforded protection from interference.

Trading proposals

Test and development licences

9.8.8 Where spectrum trading is introduced, Ofcom believes it is inappropriate to include a licence obligation for licence holders to permit T&D activities in their spectrum on request.

9.8.9 In a trading environment, users requiring test and development licences would be required to purchase on the market temporary rights to use spectrum, with an undertaking to ensure appropriate protection from interference as required by the primary owner. Given the level of interference protection that T&D licences currently confer, that is they can be revoked without compensation if interference is caused to other authorised users, such licences are unlikely to be expensive. Allowing the opportunity to purchase T&D rights, rather than relying on voluntary permission as currently, may have the effect of increasing the range of frequencies available, although this might reasonably be reflected in the price charged.

9.8.10 In addition, in certain circumstances Ofcom may make vacant (unassigned) spectrum available for test and development purposes.

Use for scientific purposes

9.8.11 Radio astronomers have particularly specific requirements. For example, there is fundamentally no flexibility in choice of spectrum for some research activities, for example, when observing hydrogen lines. As a result the users of scientific spectrum have limited ability and incentive to trade.

9.8.12 However, that is not to say that trading should not be granted, and the licensee given the option to trade if they wish. Ofcom will consider introducing rights to trade RSA when they are introduced. Granting of RSA in this licence class is unlikely to take place before 2005.

Licence exempt spectrum

9.8.13 Ofcom is not proposing to extend spectrum trading to licence exempt spectrum. Ofcom would have no powers to do so even if it wanted to. By the very nature of this spectrum, users share their rights of use with all other users. Therefore, they do not have rights that they can trade.

9.8.14 Ofcom will ensure that users and other interested parties have ready access to its plans for licence exempt spectrum so they can take these into account in their trading activities. This includes information currently available as part of the UK Plan for Frequency Authorisation on the RA website.

9.8.15 Ofcom is obliged by the Communications Act to designate new allocations of spectrum as licence exempt unless the nature of interference obliges it to assign individual licences. In future, as technologies such as software-defined radio advance, Ofcom may make much greater use of licence exempt spectrum in its approach to spectrum management.

Question 28:
Do you agree with the proposals for application of trading to science and technology spectrum, and that trading is inappropriate for licence exempt spectrum?

9.9 Emergency services and Ministry of Defence

Description of licence class

9.9.1 Emergency services licences are different for each type of emergency service, in order to reflect differing arrangements with the police, fire authorities, and health service. However, each has spectrum dedicated for emergency use and for local co-ordination at major incidents.

9.9.2 The MoD manages its own spectrum under Cabinet Office arrangements. There are no licensing arrangements for the spectrum that the MoD manages, although in some instances (for example on vessels), the MoD may take out a civil licence to use civil frequencies.

Trading proposals

Emergency services

9.9.3 A number of issues regarding service interoperability and NATO constraints would need to be resolved before trading may be introduced to emergency services spectrum.

9.9.4 Ultimately, Ofcom regards this spectrum as potentially tradable, although it will need to be done in a way that ensures that spectrum for emergency use is not compromised. In order to achieve this, tradability could be introduced for emergency services licences along the same lines proposed for Private Business Radio (discussed in Section 9.5).

9.9.5 Ofcom currently expects tradability to be introduced by the end of 2006. This area will be subject to further detailed consideration and consultation.

Ministry of Defence

9.9.6 Ofcom proposes that the MoD will be able to realise the benefit of trading parts of the spectrum that it controls. Since it also pays Administrative Incentive Prices on a comparable basis to commercial users, it will then face similar incentives to use spectrum efficiently as do commercial licensees.

9.9.7 The MoD should be permitted to package the spectrum that it makes available to the market as it considers appropriate. Ofcom will continue to support the MoD in such plans. This will include outright sale of spectrum, fixed term leases, or short notice rental. In order to provide the MoD with incentives similar to commercial licensees, the proceeds from such sales or leases should remain with the MoD, subject to the agreement of the Treasury and an administrative charge that Ofcom may charge for managing the assignment process.

9.9.8 As a crown user, the MoD does not hold WT Act licences for its spectrum. The most appropriate process might be for the MoD to release this spectrum to Ofcom, who would then define licence terms and introduce the spectrum to the market as a primary assignment on behalf of the MoD. The proceeds would then be transferred to the MoD, subject to the terms of the settlement with the Treasury.

9.9.9 Once such a primary assignment had been made, the spectrum would be tradable on the secondary market. The circumstances in which changes of use or reconfiguration would in principle be permitted may be specified in the licence or lease agreement, and may be subject to MoD approval.

9.9.10 Ofcom expects that these arrangements would apply from the end of 2004. In addition, the MoD will continue to work with Ofcom on wider issues of spectrum policy through the Cabinet Office Spectrum Strategy Committee. For aviation purposes, MoD's requirements will continue to be met through the CAA.

Question 29:
Do you agree with the proposals for application of spectrum trading to the emergency services and Ministry of Defence?

Annex A

List of Questions

Question 1:
(a) Do you believe that spectrum trading will be beneficial to consumers, businesses and radio users?
(b) What could Ofcom do to increase the benefits and mitigate the disadvantages of spectrum trading?

Question 2:
How could Ofcom's proposals for spectrum trading be amended to reflect the potential benefits of emerging transmission technologies?

Question 3:
(a) Should tradability be universal within licence classes, and not an option, as proposed?
(b) Do you agree that liberalisation of spectrum use should be implemented through issuing guidance rather than through the precise definition of licence terms?

Question 4:
Are there any reasons why existing licence holders should not be authorised to participate in the trading process? If so, please provide details of which types of licence holders you consider should be excluded from the new trading process and why.

Question 5:
Should RSA be tradable?

Question 6:
Do you think trading should be introduced more or less rapidly than suggested above?

Question 7:
(a) Do you anticipate problems in defining the right to transmit in terms of transmitted power or equivalent isotopically radiated power and a 'spectrum mask', and if so what?
(b) What alternative approaches (such as standardised frequency trading units) would you prefer?

Question 8:
(a) How important is it to provide guidelines on levels of interference for each licence class?
(b) Do you anticipate any problems in doing this, and if so what?
(c) What alternative approaches might Ofcom adopt?

Question 9:
(a) Do you agree that on the introduction of trading, current licences should have a rolling term with a defined notice period for termination?
(b) What notice period do you think would be appropriate?

Question 10:
(a) In what circumstances do you believe it would be appropriate for Ofcom to revoke or serve notice on licences?
(b) Would the proposed guidelines provide sufficient certainty to licensees and potential purchasers and sufficient flexibility for the necessary management of the spectrum by Ofcom?
(c) Are there circumstances in which it might be appropriate for Ofcom to have a power to terminate licences on shorter notice, with compensation?

Question 11:
What problems do you anticipate in separating non-spectrum licence conditions (such as roll-out obligations) from spectrum-related licence conditions, and allowing licensees to pass on their obligations as part of a trade should they wish?

Question 12:
(a) What intermediaries do you expect to emerge in the market for spectrum licences?
(b) Are there any features of intermediaries which may require regulation?

Question 13:
Do you agree with Ofcom's proposed arrangements for the spectrum currently managed by JFMG, JRC, CSS and the CAA?

Question 14:
Do you agree with the extent of information that Ofcom is proposing to make available to the market?

Question 15:
(a) What problems do you anticipate in the process for administering spectrum trading?
(b) Do you agree with Ofcom's outline procedure?

Question 16:
(a) What kind of leasing and hiring arrangements do you envisage arising?
(b) Do you agree with Ofcom's proposed arrangements for approval and registration of spectrum leases and hires?

Question 17:
(a) Do you think liberalisation of spectrum use as proposed should be pursued as well as trading?
(b) Do you agree with the constraints on liberalisation outlined above?

Question 18:
(a) Do you agree with the proposed process for approval of licence reconfigurations or changes of use?
(b) Are there any other factors which Ofcom should take into account in whether or not to approve an application for a change of use?
(c) Should Ofcom make commitments to performance targets for assessing applications for change of use?

Question 19:
(a) What types of disputes do you envisage arising as a result of spectrum trading and licence liberalisation?
(b) Beyond its statutory duties on disputes, how far should Ofcom become involved?

Question 20:
(a) Do you agree that an assessment of whether a spectrum trade can be expected to result in a substantial lessening of competition is appropriate?
(b) How should such a test be applied in practice?

Question 21:
In what ways do you anticipate that administrative incentive pricing will need to be changed to take account of spectrum trading?

Question 22:
Do you agree with the proposals for application of spectrum trading to television and radio broadcasting spectrum?

Question 23:
Do you agree with the proposals for programme-making and special events spectrum?

Question 24:
Do you agree with the proposals for application of spectrum trading to public wireless networks?
Specifically, do you agree with:
(a) the proposed timing of its introduction;
(b) the proposals for the extent of licence reconfiguration and change of use that would in principle be permissible; and
(c) the proposals for amendment to licence conditions?

Question 25:
Do you agree with the proposals for application of spectrum trading to private business systems?
Specifically, do you agree with:
(a) the proposed timing of its introduction;
(b) the proposals for the extent of licence reconfiguration and change of use that would in principle be permissible; and
(c) the proposals for amendment to licence conditions?

Question 26:
Do you agree with the proposals for application of spectrum trading to fixed terrestrial and satellite links? Specifically, do you agree with:
(a) the proposed timing of its introduction;
(b) the proposals for the extent of licence reconfiguration and change of use that would in principle be permissible; and
(c) the proposals for amendment to licence conditions?

Question 27:
Do you agree with the proposals for application of spectrum trading to maritime and aviation spectrum? Specifically, do you agree with:
(a) the proposed timing of its introduction;
(b) the proposals for the extent of licence reconfiguration and change of use that would in principle be permissible; and
(c) the proposals for amendment to licence conditions?

Question 28:
Do you agree with the proposals for application of trading to science and technology spectrum, and that trading is inappropriate for licence exempt spectrum?

Question 29:
Do you agree with the proposals for application of spectrum trading to the emergency services and Ministry of Defence?

Annex B

Regulatory impact assessment

B.1 Proposal, purpose and intended effect

B.1.1 Ofcom is proposing to introduce a secondary market for rights of use to the radiofrequency spectrum. This proposal applies to the whole of the United Kingdom.

B.1.2 The intended effect of this secondary market is to allow spectrum to be used by those who value it the most. In particular, it is anticipated that the introduction of spectrum trading will facilitate:

- reassignment of spectrum from low economic value uses to high economic value uses;
- efficient companies to expand and displace less efficient companies;
- increasing opportunities for entrepreneurs to access spectrum to introduce innovative technologies and new services;
- a reduction in the transaction costs of acquiring rights to use spectrum;
- improved efficiency of spectrum use through the action of market mechanisms; and
- support for other policy objectives, such as the potential release of licensed spectrum for wireless broadband systems in rural areas.

B.2 Risk assessment

B.2.1 The introduction of trading represents a fundamental shift in the way spectrum management takes place in the United Kingdom. As outlined in Section 4, Ofcom believes there are compelling reasons to introduce trading, and significant risks associated with not doing so.

Risks of inaction

B.2.2 The risks of not introducing trading revolve around the loss of the potential economic efficiency benefits which would result from trading. In future, the potential losses from not introducing trading are likely to become still more severe, as demand for spectrum continues to increase and Ofcom is forced to make ever more difficult judgments regarding the relative value of competing applications.

B.2.3 Such a continuing and increasing need for intervention by Ofcom for spectrum planning and management purposes would increase regulatory uncertainty for users of spectrum and could act as a disincentive to investment.

Risks of introducing trading

B.2.4 Nonetheless, such a dramatic shift in spectrum management policy as the introduction of trading brings with it a new set of risks, which could potentially destabilise the current managed spectrum ecology. In devising proposals for trading, Ofcom has sought to minimise or mitigate such risks wherever possible.

B.2.5 These risks have been summarised into eight principal categories, outlined in the Exhibit 18. The exhibit also discusses the factors, including actions that Ofcom may take, that mitigate these risks.

Exhibit 18: Risks of spectrum trading

Area of risk	Example risks	Mitigation
Lack of trading activity	• Inertia: owners are unwilling to migrate even in the face of the incentives that trading brings, preventing the benefits of spectrum reallocation • Limited initial pool of tradable spectrum: the initial wave of tradable spectrum may be too limited to give sufficient liquidity to the market • Limited liquidity: 'thin' market results with limited opportunities to trade, preventing incoming users easily acquiring spectrum, including in the market for short-term access to spectrum • Intermediaries may not emerge: this inhibits trading and prevents flow of information to the market	• Alongside the development of a secondary market, Ofcom has sought to provide a further incentive to trade under-used spectrum through retaining administrative incentive pricing • Ofcom has sought to introduce tradability as quickly, and in many licence classes, as possible, in order to provide the largest possible pool of tradable spectrum and maximise liquidity • Limits on attractiveness to trade, such as restrictions on change of use, have been limited to only those essential for engineering, harmonisation or policy reasons • Ofcom has sought to encourage the emergence of trading through public provision of sufficient data to enable trading activity
Anti-competitive action	• Anti-competitive hoarding: players occupy spectrum in order to block entry by competitors into their markets • Excessive pricing: where holders of rights to use spectrum are effectively monopolists in particular spectrum bands, they may seek to extract monopoly pricing from spectrum users. This risk is particularly strong for bands with non-frequency agile equipment, preventing users migrating to other bands and other suppliers of spectrum	• Ofcom will address anti-competitive action as a result of trading through timely and rigorous application of competition and merger law • In addition, Ofcom will assess trades and prevent those that it believes may have the effect of a substantial lessening of competition
Inefficient use of spectrum	• Fragmentation: trading results in incumbents occupying small sections of the spectrum scattered throughout bands. High transaction costs prevent acquisition of continuous blocks of sufficient size to introduce new applications	• Ofcom believes that the market is best placed to deliver efficient use of a scarce resource, rather than any regulatory alternative

Exhibit 18 (contd.): Risks of spectrum trading

Area of risk	Example risks	Mitigation
Inefficient use of spectrum (contd.)	• Definition of spectrum access rights: there may be a need for greater inter-user separation in the form of guard bands than currently, resulting in reduced spectral efficiency • Single user blocking access: a user of a small proportion of a particular band may attempt to 'hold out' when an incoming user buys a whole block of spectrum. The small user may attempt to extract the majority of the economic rent available to the incoming user	• However, where necessary Ofcom will act to counter inefficient fragmentation through negotiation with licensees, and ultimately, give notice of termination of licences to facilitate re-planning of a spectrum band • Some reduction in efficiency may result from licence re-definition. However, Ofcom considers that such reduced technical efficiency will be more than offset by the increased economic efficiency resulting from the action of a secondary market
Increased interference	• Reduced flexibility on interference issues: licensees may be less flexible in adjusting their own usage to avoid interference • Increase in number and complexity of interference complaints • Changes in the definition of emissions rights do not accurately reflect rights currently held, or customary use by users – resulting in interference disputes over current transmission levels	• Ofcom will develop a robust dispute resolution procedure, including scope for bilateral negotiations to resolve interference disputes and adjudication by Ofcom where mutually agreed solutions cannot be found • Proposed changes of use or reconfiguration will be subject to prior approval, and will be refused if it is considered that they may result in undue interference to other spectrum users
Reduced innovation	• Reluctance to accommodate test and development: with a more 'ownership-oriented' model for spectrum use, incumbents may not be as accommodating to non-commercial use of spectrum for test and development. Innovation and spectral efficiency may be reduced as individuals may lack the financial wherewithal to compete on the secondary market	• In general, Ofcom believes that trading will encourage innovation, development and investment in new technologies through reducing the barriers to acquisition of spectrum for new uses

Exhibit 18 (contd.): Risks of spectrum trading

Area of risk	Example risks	Mitigation
Risk to safety of life services	• Difficulty of acquisition for safety of life applications: public bodies may only be able to acquire any additional spectrum requirements by purchasing through the market, which may be prohibitively expensive • Increased interference: potential interruption of safety of life services by undue incoming interference from other users	• Protection for safety of life services will be paramount in Ofcom's consideration of interference disputes and prior approval for changes of use and reconfiguration • Public sector users will be exposed to the economic value of the spectrum in the same way as private sector organisations. If it was considered that the overall economic and social benefit from the potential use exceeded the cost of the spectrum, then the necessary public sector funds would need to be sourced to meet this spectrum need.
Implementation risks	• Licence amendment: the need to complete the necessary licence amendments before licences become tradable may delay the introduction of trading in certain classes • Updating records: there is significant effort required to update the records currently held by the RA which will underpin the public register and provide engineering information for licensees seeking to change use or reconfigure licences	• Ofcom believes that the timetable for the introduction of trading, outlined in this consultation document, is feasible and desirable in terms of delivering maximum possible economic benefit as soon as possible. • However, Ofcom will monitor progress and expenditure in order to counteract implementation risk, through speedy resolution of unforeseen problems and effective specification of requirements.
Disruption to consumers	• Where licensees decide that a service is unprofitable and sell their licences, consumers may be left with redundant radio equipment • Reconfiguration of licences may be profitable for suppliers of certain services but require consumers of those services to retune their reception equipment, or even buy new equipment	• Ofcom's approval will be required before any proposed change of use is approved. Where necessary, Ofcom will require licensees to consult with end users before approval is granted

B.3 Benefits

Expected benefits from trading

B.3.1 Economic theory shows that in general, markets are better at allocating scarce resources than regulatory planning. Therefore, where spectrum is not assigned or allocated efficiently, the use of a market mechanism, (e.g. spectrum trading) can increase economic efficiency. If the value of the spectrum for an existing user is lower than that of a potential user, both will benefit from trading the spectrum and there will be a net gain to the economy as a whole.

B.3.2 The benefits that spectrum trading will bring include:

- *Re-assignment of spectrum from low value uses to high value uses to maximise economic efficiency.* Excess demand for spectrum may arise because demand for end-user services rises or new technology enables new applications. Under an assignment-based system, Ofcom would find it extremely difficult continually to evaluate changes in the value of spectrum in different uses and re-allocate spectrum accordingly.
- *Efficient companies will be able to acquire spectrum from inefficient ones within the same use.* Under an assignment-based system, where Ofcom assigned spectrum on a first come first served basis for a particular use, spectrum would not necessarily go to the most efficient firms.
- *Greater competition in popular services.* Spectrum trading may reduce barriers to entry by allowing new firms to enter a market, bringing downward pressure on prices and increased consumer choice.

B.3.3 Where the normal functioning of markets is impaired, for example by the existence of externalities resulting from interference, then the markets may move away from an economically efficient optimum. However, many such situations may be transient or corrected by the market itself [21].

Demonstrated benefits of trading in other markets

B.3.4 The experience of spectrum trading in other markets can help to illustrate the benefits that spectrum trading could bring to the UK. Three case studies representing typical trading situations are presented below in Exhibits 19 to 21, describing the nature of trade and outlining the qualitative and quantitative benefits which arose from trading.

21. For example, assume a company enters a market and its service causes significant interference to an incumbent firm's service. The interference could be eliminated if the new entrant installs interference prevention devices. The incumbent will have an incentive to pay the new entrant to do this if the cost is less than the amount the incumbent would lose because of the interference, plus any transaction costs.

Exhibit 19: Transfer of 2.4GHz licences from TARBS to Austar – Australia

In October 2001 Austar, an Australian radio and television broadcaster with interests in Internet and data communications services, purchased the MMDS (Multimedia Multipoint Distribution Service) licences of TARBS, a pay TV and radio broadcaster targeting ethnic communities. Austar wanted to use this spectrum to provide high speed data services to business and high end consumers.

Nature of Trade

98MHz of spectrum was transferred in the 2.4GHz band covering the geographical metro-city areas of Sydney, Melbourne, Brisbane, Canberra, Adelaide and Perth. To enable the change of use from television and radio broadcast to delivering high speed data services, TARBS had to convert its MMDS licences from apparatus licences to spectrum licences and was charged an administrative fee for doing so.

Economic value of trade

Austar paid TARBS A$140m for the licences which TARBS had acquired for A$60m[1]. This represented a gain to TARBS of A$80m or 133 per cent[2], excluding transaction costs. Austar also agreed to explore opportunities to distribute TARBS pay TV content over its own networks (and those of its parent UGC), however the value of this commitment is difficult to estimate.

TARBS also incurred additional costs in moving the customers previously served by MMDS to satellite service delivery. These included any additional capital and operating costs in using satellite as opposed to MMDS and reconfiguring and/or replacing customers' TV sets.

Conclusions

Substantial economic benefits were unlocked by this trade and in particular by the fact that a change of use was allowed. The spectrum was more valuable to Austar for delivering high speed data services than to TARBS in its initial use of broadcasting, therefore economic efficiency was increased.

1. This included the cost of converting the apparatus licences to tradable 'spectrum licences'
2. This is a proxy for the gain in economic welfare, because the prices paid by the TARBS in the original auction and subsequently by Austar may both be less than the true value of the spectrum to each.

Exhibit 20: Transfer of 26GHz licences from Formus International to Clear – New Zealand

In March 2000, Clear Communications (now TelstraClear) bought five 26GHz LMDS (Local Multipoint Distribution Services) licences, from Formus International. Clear already had one LMDS licence and wanted to use the spectrum to to provide broadband services to business customers. Formus International, which was operating LMDS networks in Europe, acquired the licences at auction in 1998, but never exploited them.

Nature of trade

1450 MHz of national spectrum were transferred with management rights of 20 years starting from 1998. These rights were transferred to Clear when it bought the licences. No change use was involved in this trade, although such a change was permitted under the management rights system. The spectrum enabled Clear to be able to provide a nationwide LMDS service.

Economic value of trade

Formus bid NZ$2.4m for the five licences at auction and Clear paid Formus NZ$3m for the licences, a gain of around 25 per cent.

Conclusions

Spectrum trading produced two separate benefits in this case. Firstly, Formus had not begun to exploit the spectrum. Clear was in a better position to use it and so the economy benefited. Secondly, Clear would potentially have been able to generate more value from the licence by virtue of exploiting economies of scale and scope with its other telecoms services. Formus, as a new entrant to the telecoms market in New Zealand, did not enjoy these advantages.

Exhibit 21: Release of spectrum from TV3 to create space for a new broadcaster, TV4 – New Zealand

In 1997, the VHF spectrum used by the New Zealand broadcaster TV3 was re-engineered to release sufficient spectrum for the creation of a new television channel, TV4. TV3 and TV4 were owned by the same parent company, CanWest Global.

Nature of trade

TV3's licence had been converted into a tradable spectrum licence in 1989, when spectrum trading was introduced in New Zealand, though the Crown retained the management rights to the spectrum. TV3 was required to pay a fee related to the estimated market value of the licence.

When TV3's 'spare' spectrum was released to TV4 no payment was made between the companies (in any case a payment would have been internal to their parent company). However, TV3 did pay the New Zealand government an administration fee. Effectively the spectrum was traded at a price close to zero, and would not have been possible had TV3 not had tradable spectrum rights.

Economic value of trade

Although the spectrum was traded at a price of zero, the gain to the economy was significant. The value of the spectrum effectively increased because of the discovery of the engineering solution which released the additional spectrum, and the parent company of TV3 and TV4 made a substantial windfall gain. The New Zealand economy gained too through the profits and consumer benefits which the new TV station has generated and is expected to generate in the future.

Conclusions

Spectrum trading generated considerable benefits in this case, even though the change in the value of spectrum was not readily apparent from the trade. The potential for trading gave TV3 an incentive to examine whether it could use its spectrum more efficiently.

Quantifying the benefits - approach

B.3.5 The welfare gain to the economy from a spectrum trade is the difference between the buyer's valuation of the spectrum and the value of the spectrum to the seller, i.e. the buyer pays a premium over the seller's valuation, which reflects a proportion of the additional value he perceives. Economic efficiency is improved because the buyer expects to earn more profits over the duration of the spectrum licence than the seller, and therefore values the spectrum more.

B.3.6 The overall potential benefit from introducing spectrum trading is the sum of all current and future welfare gains from trade (discounted to take account of the fact that £1 earned in the future is worth less than £1 earned today). This measure is called the Net Present Value (NPV) of the expected gains from trading.

B.3.7 A quantitative estimate of the benefits of trading is difficult to achieve directly, because it relies on necessarily subjective judgements of how much excess demand for spectrum has arisen due misallocations of spectrum, either between different types of spectrum use, or between companies with the same use for the spectrum. In addition, a very detailed and necessarily judgemental technical and economic analysis would be required to predict what future potential uses the spectrum may be employed for, whether these will create excess demand, and what sort of volumes of trades might result.

B.3.8 Since much of this information cannot be directly quantified, particularly that information which depends on uncertain future developments, Ofcom has sought to proxy these factors through consideration of:

- the pattern of spectrum trading in other countries;
- information relating to marginal values of different areas of the spectrum, which underpins administrative incentive pricing in the UK; and
- qualitative analysis of excess demand, based on the understanding of business units of the RA.

B.3.9 Many of the benefits of spectrum trading are expected to manifest themselves in dynamic benefits such as increased competition and more rapid introduction of new innovative services. Such dynamic benefits are significantly more difficult to predict and therefore quantify, than the static benefits which result when spectrum currently employed for one application is traded and then used by a more valuable application. Though hard to quantify, dynamic benefits are likely to be large and may substantially exceed the static benefits.

B.3.10 This analysis calculates only the static benefits arising from spectrum trading in the United Kingdom. It uses a six-stage methodology:

- estimation of the volume of trades over time, based on international experience;
- identification of a proxy for the value of the spectrum to the current user;
- identification of licence classes where trading would be permitted, and what constraints on the nature of trading are proposed;
- in licence classes where change of use is permitted in principle, identification of the most valuable alternative use of the spectrum;
- where change of use is involved in a trade, calculation of the difference between the value to the buyer given the new use, and value to the seller; and
- where change of use is not involved in a trade, estimation of the typical difference in value of the spectrum between the seller and the buyer.

B.3.11 The **volume of trade** has been estimated by assumed that 8 per cent of tradable licences change ownership in a given year. This is based

upon the experience of spectrum trading in Australia, outlined in Exhibit 22, where on average 8 per cent of tradable spectrum licences changed ownership in the early years of trading. It may be conservative to apply this experience directly to the UK, given the UK's much higher levels of spectrum congestion in many areas of the spectrum.

Exhibit 22: Australian spectrum licence trades (source: Australian Productivity Commission)

	Trading volume	Turnover
1998-99	50	13.8%
1999-00	22	5.4%
2000-01	47	7.7%
2001-02	51	8.4%

B.3.12 In calculating volumes of trades for fixed links, a further adjustment has been made. A trade is only likely to occur where one operator's demand for a link coincides with the location of another operator's existing link. This is much more likely to happen on major trunk routes than other routes. Therefore it has been assumed that no more than 20 per cent of the value of the fixed link market will relate to such congested routes, taking account of the fact that major trunk routes carry more traffic than average.

B.3.13 For each licence class, an **average proxy value of spectrum** to the incumbent is calculated, based largely on analyses by NERA & Smith System carried out for the Radiocommunications Agency in 1996 and 1998 [22]. In addition, a number of alternative approaches have been required for services which fell out of the scope of the NERA Smith studies. In particular, the value of spectrum for point-to-multipoint fixed links and scanning telemetry are calculated on the basis of existing licence fees [23]. The average auction price per licence is used for auctioned fixed wireless access licences, and the total licence fees paid under the Broadcasting and Wireless Telegraphy Acts has been used for broadcasting licences.

B.3.14 The value that can be realised from trading is constrained by the **licence classes where trading is permitted, and any constraints on trading.** The timing of the introduction of trading and the extent to which change of use may be possible has been taken into account by the analysis.

B.3.15 Where change of use is proposed, **the most valuable alternative** use has been identified, drawing extensively on a study currently underway to review administrative incentive pricing [24]. This study identifies potential sources of excess demand for spectrum areas from alternative uses.

B.3.16 The margin on trade has then been calculated as the **difference between the buyer's and the seller's valuation of a licence**. Two possibilities are investigated. Where **trades involve a change of use**, the gain on trade has been estimated as the difference between the buyer's proxy valuation of the spectrum in its new use, and the seller's proxy valuation in the previous use.

B.3.17 Where there is **no change of use** of the spectrum, the buyer's valuation has been represented as a simple percentage increase on the seller's valuation. The Myerson Satterthwaite [25] result shows that when there is incomplete information, (i.e. buyers and sellers in a trade do not know each other's truevaluations), there has to be a difference in valuations of at least 25 per cent for a trade to take place.

22. Study into the Use of Spectrum Pricing (1996), Review and Update of the Spectrum Pricing Models (1998)
23. These licence fees are based on the Spectrum Tariff Unit which is an average tariff per MHz of spectrum used. This average tariff was set at 50% of the marginal values on which it was based, therefore the licence fees were multiplied by a factor of two in the calculation.
24. An Economic Study to Review Spectrum Pricing: Phase A (2003), Indepen Consulting, Aegis and Warwick Business School.
25. Myerson, Roger B.; Satterthwaite, Mark A. 1983. 'Efficient Mechanisms in Bilateral Trading', Journal of Economic Theory 29 (April): 265-81

B.3.18 Therefore, we have assumed that a simple transfer of ownership with no change of use results in a gain in economic value equal to 25 per cent of the value of the licence to the previous owner. In practice, it is likely that the gain on trade would be greater than 25 per cent of the value to the incumbent, as this marks a threshold value over which a trade is likely to proceed. Consequently, this approach may underestimate the economic benefit which results from trading, where no change of use results.

Quantifying the benefits – valuation

B.3.19 Exhibit 23 outlines the application of this framework to estimate the benefits of spectrum trading in the principal licence classes. The total potential benefit from trading has been calculated for each of the licence classes where trading will be introduced by 2007, with the exception of emergency services, aviation and maritime, Ministry of Defence and 3G mobile spectrum.

B.3.20 As demonstrated in Exhibit 24, the benefits from trading are conservatively estimated to lie in a range from £19m (with no change of use) to £27m (with maximal change of use) per year, depending on the degree to which the permissible changes of use actually take place. With the phased introduction of trading, the magnitude of the economic benefit from trading will be constrained in the early years until trading is introduced in the most valuable licence classes, namely broadcasting and cellular telephony. This is not anticipated before 2007.

B.3.21 Exhibit 24 demonstrates how the economic benefit of trading is expected to escalate with the introduction of trading in a greater number of licence classes. It shows the range of economic benefit that might be realised, depending on the degree to which change of use which is permitted in principle actually takes place.

B.3.22 The benefits from introducing spectrum trading are estimated to lie within the range of £180m to £270m in terms of the Net Present Value over a period of 20 years, assuming a discount rate of 6 per cent (consistent with Treasury guidelines). The lower bound assumes that there is no change of use. The upper bound assumes that where change of use is in principle permitted, all trades involve change of use.

B.3.23 This analysis assumes that economic benefit from trading is linear with respect to volumes of trades, Therefore 50 per cent of the economic benefit will result from 4 per cent turnover of licences per year, compared with the base case 8 per cent turnover. A 50 per cent increase in the volume of trades will result in an economic benefit 50 per cent higher than the base case. Exhibit 25 illustrates the range of economic benefit that could result from spectrum trading depending on the volume of trades and the degree to which potential changes of use take place.

Exhibit 23: Potential annual benefit of spectrum trading by licence class

Licence class	Licence product	Licences	Current value per licence, £	Value in next best use, £	Next best use	Benefit: no change of use[26], £000s	Benefit: change of use, £000s
PBR	National/ regional PBR	69	25,800	n/a	same use	35.6	35.6
	On-site PBR	26,000	550	2,250	PAMR	286	3,536
	Shared wide area data	3	3,796	9,450	PAMR	0.2	1.4
	Wide area PBR	13,000	3,796	9,450	PAMR	987	5,879
	Wide area PBR alarms	18	7,235	9,450	PAMR	2.6	3.2
	Wide area PBR paging etc	340	7,235	9,450	PAMR	49.2	60.2
	Common Base Stations	350	2,250	3,796	PMR	15.8	43.3
Fixed links	less than 13GHz	2,105	48,067	n/a	same use	405	405
	13-20GHz	3,558	16,007	n/a	same use	228	228
	greater than 23GHz	7,225	16,007	n/a	same use	465	465
	Point-to-multipoint	54	1,960	n/a	same use	2.1	2.1
	Scanning telemetry	66	15,840	n/a	same use	20.9	20.9
Public Wireless Networks	3.4 GHZ FWA	15	463,667	n/a	same use	139.1	139.1
	Data networks	6	9,450	25,800	PMR	1.1	7.8
	National paging	5	9,450	25,800	PMR	0.9	6.5
	28GHz FWA	15	2,534,000	n/a	same use	760.2	760.2
	Band 3 (not sound broadcast)	1	9,450	n/a	PAMR	0.2	0.2
	PAMR analogue	5	9,450	18,900	cellular	0.9	3.8
	PAMR digital	1	18,900	n/a	same use	0.4	0.4
	Remote meter reading	3	56,000	n/a	same use	3.4	3.4
	GSM	4	84,500,000	n/a	same use	6,760	6,760
Broadcasting		1[27]	436,000,000	n/a	same use	8,720	8,720
Total						18,856	27,177

26. For a simple change of ownership with no change of use, the value of the spectrum to the buyer is assumed to be 25per cent higher than to the seller. On average 8per cent of all licences are assumed to be traded each year
27. The number of licences is artificially set to one since the estimate of the current value of broadcasting licences is for the whole sector and not an average per licensee.

Exhibit 24: Annual economic benefit of spectrum trading, £ 000s

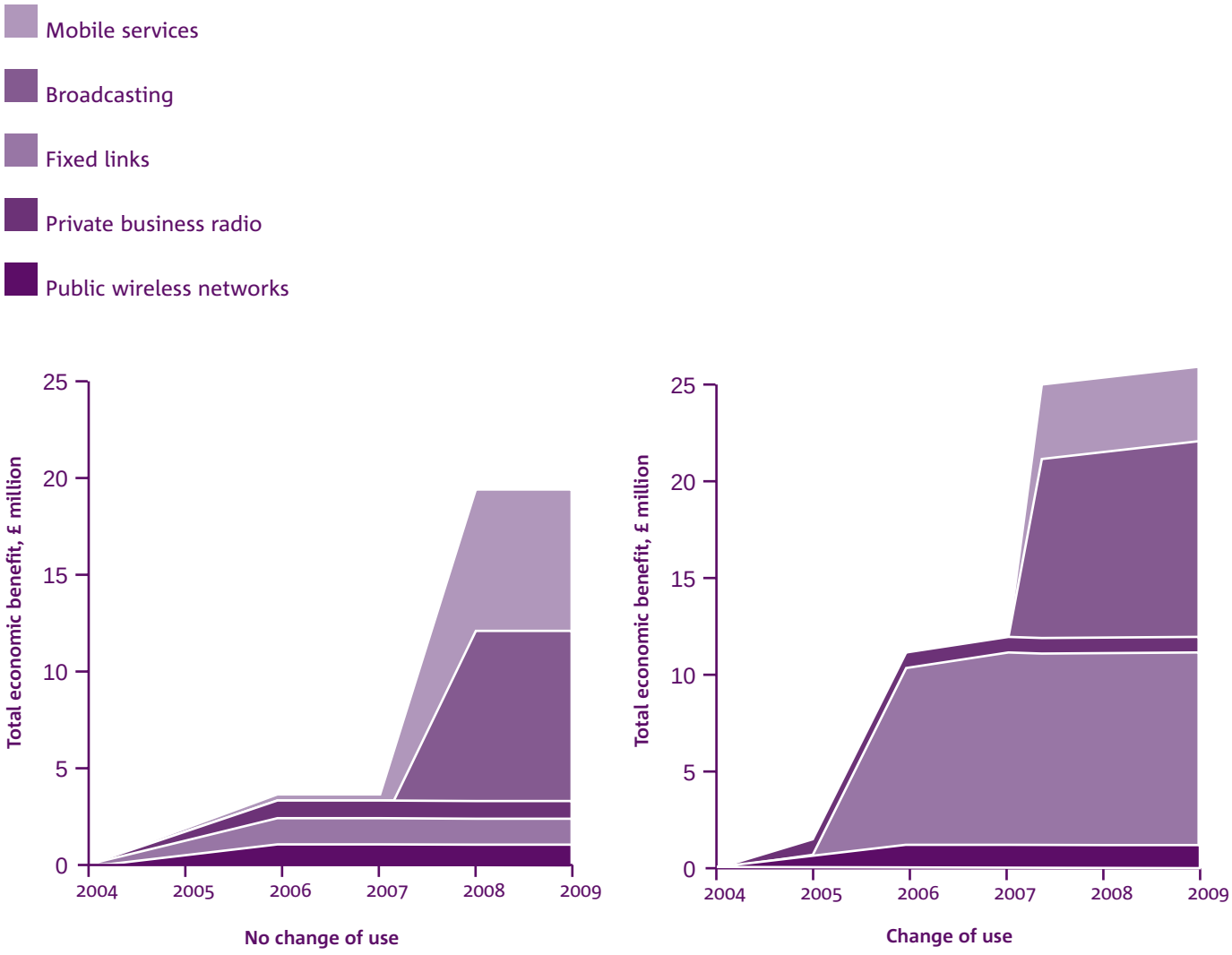
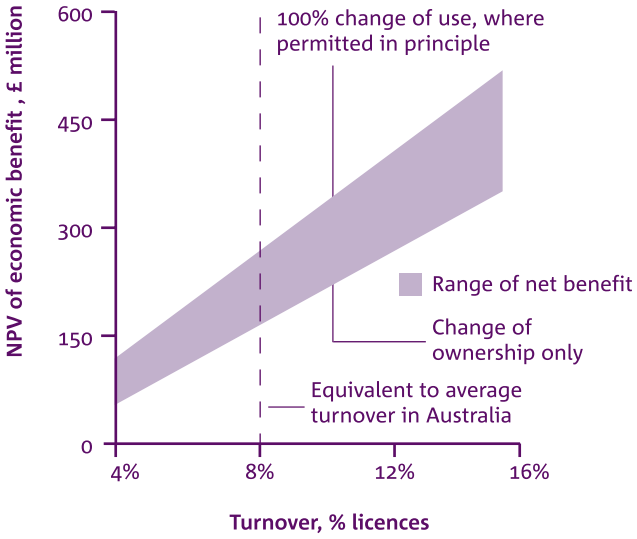


Exhibit 25: Range of economic benefit estimated as a result of trading, £ millions



B.3.24 This estimate of range of the benefits from spectrum trading is in fact conservative in a number of ways.

- It only considers the 'static' benefits of trading, not any dynamic benefits (in terms of better access to innovation, more competitive cost structures of companies using wireless technologies, etc).
- The benefit from potential trading of emergency services, aviation and maritime, Ministry of Defence and 3G mobile spectrum is not accounted for.
- The estimated value of spectrum to the incumbents are proxy values, based on the level of administrative incentive pricing, rather than the true value of that spectrum to the incumbent. As a result, the absolute differential in the value placed on the spectrum by the buyer and seller is likely to be higher than estimated here.
- The 25 per cent Myerson Satterthwaite condition used to derive the incremental value for trades with no change of use is a threshold value. In practice, greater economic value might be released, as the buyer may value the spectrum at a significantly greater increment to the seller.
- The next best alternatives identified in this analysis only account for known alternative uses of spectrum, and do not take account of the impact of new innovative radio technologies.

Business sectors affected

B.3.25 The benefits of trading will be realised by an extremely diverse range businesses, individuals, organisations and safety of life services in the UK who use the radio spectrum. For example, spectrum is used by businesses as diverse as:

- local taxi services, with a single wide area private business radio licence covering a single town;
- commercial properties, such as airports and shopping centres, with a range of on-site licences for relatively low power private mobile services;
- local authorities, using common base station licences to provide services to 200-300 users in a local area;
- providers of wireless broadband services for local communities;
- publicly listed companies such as cellular operators; and
- radio and television broadcasters.

Issues of equity and fairness

B.3.26 The majority of direct benefits from trading will accrue to people or companies who currently hold licences to parts of the spectrum which have the most valuable alternative uses. However, Ofcom believes that spectrum trading will benefit all users, by ensuring efficient use of the spectrum and opening up the radio spectrum to new, innovative technologies.

B.3.27 Ofcom is conscious that the large differential in relative economic resources between users of the radio spectrum could raise a number of issues regarding fair and effective competition. As discussed in Section 8.5, Ofcom is proposing to put in place processes to ensure that spectrum trading does not result in anti-competitive practices, or a reduction in the standard of interference protection that licensees currently experience.

B.3.28 The introduction of trading could also potentially result in greater scope for conflict between users, for example, where a change of use by a large user results in interference to a smaller-scale user, who may lack the funds for a complex and drawn out dispute resolution process. Ofcom is seeking to make its competition and dispute resolution procedures, as speedy, tight and accessible as possible, to facilitate fair and equitable treatment of users with limited financial resources.

B.3.29 Ofcom is seeking to consult widely with a broad range of users to reflect the concerns of smaller-scale users in the responses it receives to this consultation. To this end, Ofcom has produced a summary document, *Ofcom Consultation on Spectrum Trading - A Summary*, which provides an accessible outline of its spectrum trading proposals, and invites responses from users who would otherwise not be likely to respond to an extensive consultation document of this sort.

B.4 Costs

B.4.1 This section outlines Ofcom's estimation of the costs of introducing spectrum trading; in terms of its own administrative costs, and those of licensees.

Ofcom's incremental costs

B.4.2 Incremental costs to Ofcom are assumed to consist of:

- set-up costs relating to necessary IT systems, updating licence records and implementation resource; and
- ongoing costs associated with the administration of trading and necessary technical checks.

B.4.3 Incremental *set-up costs* for trading are anticipated to be in the range of £2.9m, including preliminary trading policy design at £0.3m, and implementation costs of £2.6m. The implementation cost includes a preliminary estimate of £0.6m for a computerised database containing records of ownership, and approximately £2m for implementation resource.

B.4.4 This estimate reflects the incremental, rather than the total cost of implementing trading. For example, many of the necessary IT systems upgrades are altered by the introduction of spectrum trading, but would be necessary even in its absence. The costs of the implementation team consists of the pay and attributable overhead costs of a Director, a Head of Spectrum Trading, a Lawyer, an Economist, a Policy advisor, a Statistician and an administrative team of five. It is expected that the implementation team will be in place for two years.

B.4.5 The **on-going costs** of trading consist of on-going management of the system, and trade-by-trade costs.

B.4.6 The management of a spectrum trading system ought in principle to be considerably less than the current assignment-led system, since complex decisions on assignment are made by the market, rather than by the regulator. However, the analysis has conservatively assumed that these running costs are the same; i.e. there are no incremental costs to general spectrum management under a spectrum trading regime, but no savings either from scaling down the assignment-led system.

B.4.7 The trade-by-trade on-going costs are based, for each licence class, on current administrative and engineering costs. The trade-by-trade costs are necessarily speculative, and more robust estimates will not be available until the details of the trading process are finalised. These estimates account for salaries, overhead, costs of administration and specialist engineering input. It should be emphasised that the costs of individual trades are expected to vary significantly.

B.4.8 Factors affecting the cost of any individual trade will include the level of preparation undertaken by the licensees, the particular set of technical spectrum issues that the block of spectrum is affected by, and international harmonisation and co-ordination issues. Conservative estimates of incremental costs per trade for three major categories of trading considered are summarised below:

- **Private business radio:** Two hours of administration to register change of use, plus one hour on average per reconfiguration and two hours per change of use, as the majority of trades will be accomplished using MASTS through a broker or equipment dealer. Total cost estimated to be £95 for simple change of ownership, £230 for change of use or reconfiguration.
- **Public wireless networks:** average of 20 hours administration and engineering required for a simple trade, at a total cost of £2,250 per change of ownership. Where the trade encompasses a reconfiguration or change of use the time requirement escalates sharply to 80 hours administration plus 80 hours engineering resource for a reconfiguration, or 100 hours administration and 900 hours technical resource for a change of use. Total cost per trade estimated at £8,900 for reconfiguration and £62,000 for change of use.
- **Fixed links:** as change of ownership refers only to a limited sub-set of operators and assignments rather than new licences, it is likely that a simple trade will require only one hour administrative effort, at a cost of around £45 per trade. Reconfiguration will require further administrative effort to reconcile and check administration with total cost of £95.
- **Broadcasting:** due to the high level of uncertainty regarding the specification of tradable WT Act licences for broadcasting it is not yet clear how much resource would be required to process a trade. Furthermore, the trades in broadcasting spectrum are expected to be extremely infrequent, so are not expected to have a significant impact on the overall level of cost. No estimate of resource has been assumed.

B.4.9 These preliminary assumptions of resource requirement per trade are based on current RA processes and cost structures. The estimates are subject to revision as the plans for the implementation of trading within Ofcom become more detailed. Costs include salaries and overheads, including general IT support, rent, personnel and finance.

B.4.10 Costs associated with Public Wireless Networks are particularly high, as a significant level of specialist engineering work will be necessary to address issues such as international harmonisation and co-ordination. In contrast, costs for Private Business Systems are expected to be limited by the introduction of MASTS, the RA's electronic assignment management tool, to which it is proposed to provide access for brokers and dealers.

B.4.11 Exhibit 26 summarises the level of administrative costs associated with trading by licence class per year when all the licence classes listed are tradable. It is assumed that the costs of administration of spectrum trading will be in the range from

Exhibit 26: Annual administrative costs associated with trading by licence class, £ 000s

Licence Product	Number of trades based on 8% turnover	*Annual cost of administration, £,000 per year*			
		Change of use, 8% turnover	Change of ownership only, 8% turnover	Change of use possible, 4% turnover	Change of use possible, 16% turnover
National and regional PBR	5.5	1.23	0.52	0.62	2.46
Common base stations	28.0	6.24	2.66	3.12	12.49
On-site PBR	2,080.0	463.89	197.41	231.95	927.78
Wide area PBR	1,068.9	238.39	101.45	119.19	476.77
GSM	0.3	0.71	0.71	0.36	1.43
PAMR digital	0.1	0.18	0.18	0.09	0.36
PAMR analogue	0.4	0.89	0.89	0.45	1.78
National paging	0.4	0.09	0.04	0.04	0.18
3.4GHZ FWA	1.2	74.88	2.68	37.44	149.75
28GHz FWA	1.2	74.88	2.68	37.44	149.75
Public data networks	0.5	29.95	1.07	14.98	59.90
Remote meter readinga	0.2	2.14	0.54	1.07	4.28
Point-to-point fixed links <13GHz	33.7	1.60	1.60	0.80	3.20
Point-to-point fixed links 13-23 GHz	172.5	8.19	8.19	4.09	16.37
Point-to-multipoint fixed links	4.3	0.21	0.21	0.10	0.41
Scanning telemetry	5.3	1.25	0.25	0.63	2.51
Broadcasting	-	-	-	-	-
Total	3,402.5	£905	£321	£452	£1,809

£320,000 per annum with no change of use and base case volumes, i.e. 8 per cent turnover of licences, to £1,800,000 per annum if there are high levels of change of use and double the anticipated base case volumes, i.e. 16 per cent turnover of licences.

B.4.11 These costs do not include ongoing input from specialists such as economists and statisticians, as the need for these resources have yet to be established. Neither do the estimated costs include incremental interference monitoring costs, as it is anticipated that any monitoring additional to that undertaken by the Radiocommunications Agency at present can be met by the redeployment of current monitoring resources.

B.4.12 The Exhibit 27 shows the total incremental cost of spectrum trading to Ofcom. It shows the Net Present Value of total incremental costs, given varying levels of trading volume and changes of use.

B.4.13 These estimates are likely to be conservative. In principle, increasingly leaving complex assignment decisions to the market should result in a less costly regime than a trading regime. The savings from this lesser role are not included in these estimates.

Costs for participants

B.4.14 For a straightforward change of ownership, we anticipate that the costs for trading borne by participants will consist of a cost recovery-based administration fee payable to Ofcom, and additional transaction costs, such as brokers' fees and technical advisory work associated with changes of use or reconfiguration.

B.4.15 At this point, it is not possible to predict accurately the level of transaction costs incurred by users. Consequently, we assume an allowance for brokers' fees equivalent to 5 per cent of estimated transaction value for brokers fees on all trades. Technical advisory work for change of use and reconfiguration of licences, for fixed services has been assumed to be £100,000 per trade, and £200,000 for other licence classes, with the exception of PBR.

B.4.16 Reconfiguration of PBR licences will be possible within the constraints of MASTS. Therefore, it is assumed that the costs of assessment of reconfiguration and change of use using MASTS will be absorbed by PMR equipment dealers at an average cost of £50.

B.4.17 Exhibit 28 shows the Net Present Value of costs to the participants in spectrum trading, given different volumes of trade and extent of change of spectrum use.

Other costs

B.4.18 Trading raises the scope for additional competition regulation activity, as the variety and complexity of potential abuses increases. To a certain extent, this may be displacement activity, as anti-competitive action that might otherwise take place in other ways manifests itself in lessening of competition due to the acquisition of spectrum.

B.4.19 The costs of spectrum-related competition reviews have not been included in Ofcom's costs in this estimate.

Exhibit 27: NPV of Ofcom costs over 20 years, £000s

	No change of use possible			Change of use possible		
	4%	8%	16%	4%	8%	16%
NPV of trade-by-trade costs over 20 years	1,564	3,309	6,255	4,729	9,624	19,414
Implementation Costs	2,923	2,923	2,923	2,923	2,923	2,923
NPV of costs over 20 years	4,487	6,232	9,178	7,652	12,547	22,337

Exhibit 28: NPV of participants costs, £ 000s

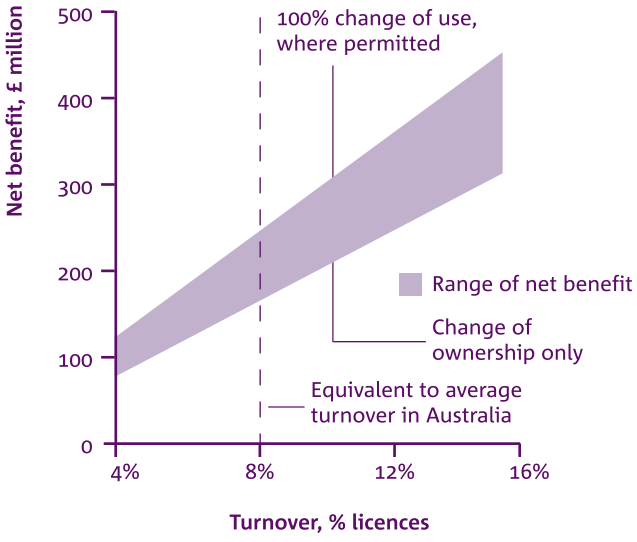
	No change of use possible			Change of use possible		
	4%	8%	16%	4%	8%	16%
Brokers fees	4,480	8,960	17,920	6,731	13,462	26,925
Technical assessment and advisory costs	-	-	-	7,648	15,297	30,595
Total participants costs	4,480	8,960	17,920	14,380	28,760	57,521

B.5 Net economic benefit

B.5.1 Based on the characteristics of trades in other countries which have introduced spectrum trading, the costs of trading have been demonstrated to be significantly less than the benefits Ofcom anticipates.

Exhibit 29 below demonstrates the range of net economic benefit anticipated from the introduction of trading in the UK, in Net Present Value terms over the next 20 years, for a range of trading volumes, whether change of use results where possible from trading, or not.

Exhibit 29: Net present value of net benefit to the UK from trading, £ millions



B.5.2 Assuming the level of turnover observed in the Australian market, i.e. 8 per cent, the net benefit to the UK economy is significant with a Net Present Value[28] in the range £164m to £228m, depending on the extent of change of use within those licence classes where it is in principle permitted. Even if volumes of trade are half that observed, (which Ofcom considers unlikely given the significantly greater level of spectrum congestion in the UK versus Australia), then the net benefit to the UK remains significant, at between £80m and £112m.

B.5.3 If the relatively high level of spectrum congestion in the UK results in a higher turnover of licenses, then the benefits from trading which would result are significantly higher. For example, it would be between £250m and £345m if the level of turnover is 50 per cent higher than occurred Australia.

B.6 Monitoring and review

B.6.1 Ofcom will monitor the success of spectrum trading in a number of ways. These include:

- *Volume of licences traded.* Ofcom will record the percentage of licences and spectrum that are traded as a proportion of the volume that is permitted to trade.
- *Maturity of spectrum markets.* Ofcom will monitor the emergence of intermediaries, including brokers, market makers, and technical consultants devoted to trading and change of use. It considers that the emergence of these kinds of organisation will reflect a vibrant and efficient spectrum market.
- *Evidence of value-enhancing trades.* Ofcom anticipates that a successful spectrum market will generate clear examples of value-enhancing trades; for example aggregation of regional licences for a national service using a different technology, or purchase of under-used spectrum by an entrepreneur with a new technology. In contrast, evidence of systematically under-used spectrum will indicate a failure of the market.

28. Assuming a discount rate of 6 per cent.

Annex C

Definition of boundary conditions in 'spectrum masks'

C.1 Ofcom's intention is that a fully flexible, tradable licence would define the right to transmit in terms of transmitted power and a 'spectrum mask'. The spectrum mask would be specified in terms of conditions experienced at a defined geographic boundary. Together, these conditions would be broad enough to be technology neutral, but sufficiently tightly defined that geographic licence boundaries could be managed effectively.

C.2 Ofcom's intention is to define these boundary conditions in terms of common physical engineering dimensions (e.g. Watts per Hertz). However, spectrum masks in different licence classes will need to be defined using different parameters. For example, definition using power spectral density will be suitable for many licence classes, but not all frequency bands or technologies.

C.3 For example, the Radio Regulations provide definitions for effective or equivalent radiated power in relation to three 'reference' antennas, which in turn are used for different broad frequency ranges. These are:

- equivalent isotropically radiated power (e.i.r.p.);
- effective radiated power (e.r.p.); and
- effective monopole radiated power (e.m.r.p.).

C.4 The first two of these are in common use for licensing and notifying the characteristics of stations already. Throughout the Radio Regulations power flux density (p.f.d), either at the Earth's surface or at some geographic boundary or test point, is used extensively as either an interference limit or a co-ordination threshold (or trigger) level. Some specific examples are the e.i.r.p. limits for terrestrial and space services sharing frequency bands above 1GHz, which may also include directionality by specifying e.i.r.p. in a particular direction, and the limits for equivalent power flux-density (e.p.f.d.). Elsewhere in the Radio Regulations e.r.p limits are specified to limit the interference from broadcasting to aeronautical services and peak e.i.r.p. density is used in respect of the mobile-satellite and radiodetermination-satellite services.

C.5 It is suggested by Cave and Webb (2003) [29] that property rights be established by setting appropriate power spectral density (PSD) limits at a distance from the transmitting antenna. The total average power in a periodic signal is the sum of the average powers in all the harmonic elements [30] of the signal. When plotted [31] , the result is the Power Density Spectrum of the periodic signal. One limitation of this approach is that this fails to reflect the phase component of the signal. The Fourier coefficients of the signal are in general complex, and provide an alternative way to plot the power spectrum: as the magnitude and the phase of the Fourier coeffcients as a function of frequency[32].

C.6 It is simple to translate power flux density (PFD) at a distance to a corresponding field strength by making some simplifying assumptions. But the measurement techniques for field strength vary considerably. High frequency (HF) field strength measurement is an example. This requires that data are taken over as wide a range of conditions as possible at a series of frequencies over paths of different lengths in all regions of the world. Measurements are needed at each hour of the day in the separate seasons and for different solar epochs.

29. M. Cave & W. Webb, Designing Property Rights for the Operation of Spectrum Markets, Papers in Spectrum Trading No.1., CMR, Warwick Business School, August 2003.
30. Where the kth harmonic element of the signal has a power $\xi C_k \xi^2$.
31. We plot $\xi C_k \xi^2$ as a function of the product of k and the fundamental frequency, f_o.
32. The concept of aperiodic signal transforms is not dealt with here.

C.7 The out-of-band spectrum of an emission is yet another key element of spectrum rights. Often prescribed by normative standards, out-of-band emissions are defined as the part of the power density spectrum (or the power spectrum when the spectrum consists of discrete components) of an emission (or emissions) which is (immediately) outside the necessary bandwidth and which results from the modulation process, with the exception of spurious emissions. It includes the effects of non-linearity, which may cause out-of-band emissions immediately adjacent to the necessary bandwidth due to odd order intermodulation products. (See Rec. ITU-R SM.328-10)

C.8 For all of these reasons, Ofcom believes that one common measure is feasible but may be limited in its application (e.g. a spectrum mask specified as PSD may be applicable to fixed wireless access operation at microwaves). At other wavelengths and for other radiocommunication services the use of PSD may be difficult to implement practically as a tradable right with regulatory meaning or status internationally.

C.9 Whilst specifying the upper and lower bounds of an assigned band seems an obvious and simple route to defining a licensee's rights over the quantity of spectrum, the different definitions prescribed by the Radio Regulations and normative standards indicate that care is needed with defining each band such that protection afforded to existing users is not diminished.

Annex D

Glossary

2G
Second generation of mobile telephony systems using digital encoding. 2G networks support voice, limited data communications, such as short messaging service (SMS), and different levels of encryption. 2G networks worldwide include D-AMPS (TDMA) and CDMA, with GSM (Global System for Mobile communications) used in the UK.

3G
Third generation of mobile systems. Provide high-speed data transmissions and higher supporting multimedia applications such as full-motion video, video conferencing and Internet access.

5.8 GHz Band C
Frequencies in the range 5725 to 5875GHz, which have recently opened for use by broadband fixed wireless access services, including Mesh Radio.

AIP
Administrative Incentive Pricing or spectrum pricing: fees charged for access to spectrum to reflect its value. AIP applies in bands for which significant demand exists for that spectrum either in its current use, or for an alternative radio service, and acts as an incentive to users to use their spectrum as efficiently as possible. AIP is currently set at a level which reflects the value of the spectrum to the user using a methodology reviewed by NERA and Smith System in July 1998, available at: www.radio.gov.uk/topics/spectrum-price/documents/spec_rev/review.htm. Following the Cave Review, further work on AIP is in progress.

Allocation
a) The process of identifying specific frequency ranges for specific applications; or b) a frequency band entered in a table of frequency allocations, for use by a particular category of services.

Analogue switch-off
Process of moving all TV households from analogue to digital terrestrial television reception and so releasing spectrum used for analogue television transmission for other uses.

Antenna
A passive device designed to radiate and receive electromagnetic energy.

Apparatus
Any equipment that is either radio equipment, or telecommunications terminal equipment, or both.

Assignment
Authorisation given by a licensing authority for a radio station to use a specific radio frequency or channel under specified conditions.

Authorisation Directive
Directive 2000/20/EC of the European Parliament and of the Council of 7 March 2002 on the authorisation of electronic communications networks and services, available at http://www.oftel.gov.uk/ind_info/eu_directives/authorisation.pdf

AVL
Automatic Vehicle Location: integration of wireless and communications and location tracking devices into automobiles to allow fleet tracking, remote diagnostics, roadside assistance etc.

Band
A defined range of frequencies that may be allocated for a particular radio service, or shared between radio services.

Band 3
Former TV broadcast band between 174 and 208 MHz, now used mainly for mobile communications.

Base station
A radio transmitter and receiver installed by an operator to provide a communications service, typically used in mobile telecommunications.

Bluetooth
Wireless standard for short-range radio communications between a variety of devices such as PCs, headsets, printers, mobile phones and PDAs.

Broadcasting Acts
The Broadcasting Act 1990 and the the Broadcasting Act 1996. These Acts will be further amended by the Communications Act 2003. These Acts govern the licensing and operation of the broadcasting industry (including the provision of cable TV services, but excluding the BBC) in the UK.

CAA Civil Aviation Authority.
A public corporation established by Parliament in 1972 as an independent specialist aviation regulator and provider of air traffic services.

Cave Review
Review of Radio Spectrum Management, by Professor Martin Cave, published March 2002, available at http://www.spectrumreview.radio.gov.uk/

CDMA
Code Division Multiple Access

Change of use
Change of technology, change of application, change in nature of business.

Common Base Stations
a) A single channel base station for PBR shared by users (also known as a community repeater); or b) a PBR installation giving wide area coverage under the control of one or more operators offering mobile communications on a commercial basis to a number of independent (usually business) users.

Communications Act
Communications Act 2003, which is expected to come into force in December 2003.

Competition Act (CA)
The Competition Act 1988, which repeals much of the earlier competition legislation in the UK.

Co-ordination Agreements
Arrangements between the UK and neighbouring countries designed to avoid harmful interference between users in different countries. Also, arrangements within the UK to limit interference between domestic spectrum users.

CPE
Customer Premises Equipment

CRCA
Commercial Radio Companies Association

CSS
C.S.S. Spectrum Management Services Ltd.

DAB
Digital Audio Broadcast: radio broadcasting using digital modulation and digital source coding techniques.

Data Networks
A network established and operated for the specific purpose of providing data transmission services for the public.

DCMS
Department for Culture Media and Sport

DTT
Digital Terrestrial Television

Earth station
Centre for communicating by radio with a space satellite.

eirp
Equivalent Isotropically Radiated Power. A theoretical measure of the power of a transmitter that radiates equally in all directions

EMC
Electro-Magnetic Compatibility: the ability of equipment or systems to be used within designated environments without causing or receiving electromagnetic interference.

Emissions
Electromagnetic energy propagated from a source, which may occur anywhere in the spectrum.

EMRP
Effective Monopole Radiated Power

Enterprise Act
Enterprise Act 2002, which, among other things, restates the current UK merger control framework with certain significant amendments

EPFD
Equivalent Power Flux Density. The equivalent power flux-density is defined as the sum of the power flux-densities produces at a point on the Earth's surface by all space stations within a non-geostationary satellite system, taking into account the off-axis discrimination of a reference receiving antenna assumed to be pointing towards the geostationary-satellite orbit.

ERP
Effective Radiated Power

e-Trading systems
An electronic mechanism designed to facilitate spectrum trading.

ETSI
European Telecommunications Standards Institute

Eureka 147
A standard for DAB, digital audio broadcasting.

Ex-ante
Before an event, e.g. a trade, takes place.

Ex-post
After an event.

FDMA
Frequency Division Multiple Access

Field Monitoring
Monitoring spectrum use in real-world situations.

Fixed Links
Communications links between fixed points. Such links may be unidirectional or bidirectional, and may be point-to-point or point-to-multipoint.

Foreclosure
Markets are foreclosed when undertakings are unable to enter the market either completely or partially. Markets may be foreclosed by a range of anti-competitive agreements or conduct by undertakings with market power. For example, where a company acquires a significant proportion of an essential supply to a market, this may effectively block access to that market for a competitor.

Framework Directive
Directive 2002/21/EC of the European Parliament and of the Council of 7 March 2002 on a common regulatory framework for electronic communications networks and services, available at http://www.oftel.gove.uk/ind_info/eu_directives/framework.pdf

Frequency Boundaries
The extremities of the radio frequency range of an assignment, specified either in terms of a central frequency with channel width, or a frequency range.

Frequency Re-Use
Re-using the same frequencies at different spatial locations, in such a manner that the frequencies are arranged so that they do not cause undue interference to one another.

Frequency Trading Units
Standard blocks of spectrum defined by frequency, time and geography to act as a common unit for trading.

FSA
Financial Services Authority

FWA
Fixed Wireless Access: radio link to the home or the office from a cell site or base station, replacing the traditional local loop.

GHz
GigaHertz, a frequency of one thousand million Hertz (cycles per second).

GSM
Global System for Mobile communications. The international operating standard for the second generation of digital cellular mobile communications.

Guard band
Frequency range between assignments to protect users on either side from out-of-band interference.

Harmonisation
Allocation of frequencies on an international basis, e.g. within Europe or globally, for particular radio services. Such frequency ranges are known as harmonised bands, or harmonised spectrum.

HF
High Frequency: portion of the electromagnetic spectrum typical used in short-wave radio applications, normally in the 3MHz to 30 MHz range.

Interface requirements
High level descriptions of how the spectrum should be used, typically consisting of the spectrum allocation table, together with requirements related to intentional transmissions in allocated frequency bands. All interface requirements are published at http://www.radio.gov.uk/, and are quoted in Exemption Regulations and in licence conditions.

Interference
The effect of unwanted signals upon the reception of the wanted signal in a radio system, resulting in degradation of performance, misinterpretation or loss of information compared with that which would have been received in the absence of the unwanted signal.

IR 2008
Standard which permits data insertion into one of eight timeslots in the two or four second cycle used by TDMA PBR services.

ITC
Independent Television Commission

ITU
International Telecommunication Union. The United Nations agency that co-ordinates and manages radio use worldwide through the international Radio Regulations that it promulgates. These have the status of an international treaty and are binding on member states.

JFMG
JFMG Ltd undertakes licensing of programme-making and special events spectrum on behalf of the RA, administering licences and collecting licence fees. JFMG Ltd, the successor to the Joint Frequency Management Group, is jointly owned by the ITV companies and the CRCA.

JRC
Joint Radio Company Ltd, which undertakes management of the scanning telemetry spectrum licensed to the gas and electricity utilities.

Land Mobile
A mobile service between base stations and land mobile stations, or between land mobile stations.

L-Band
A band of frequencies in the 0.5 to 2GHz range. The RA and the Radio Authority are currently undertaking a consultation on the future use of VHF frequencies and L-band, exploring possible applications which may include mobile services and digital sound broadcasting services.

Liberalisation
Process by which licensees may request amendments to existing restrictions or conditions in their licences to permit change of use or reconfiguration of rights to use spectrum.

Licence class
Type of licence issued by the RA, for example PAMR or Wide area PBR. Volume classes refer to those licence classes for which there are significant numbers of licensees, for example on site PBR with 26,000 licensees and on-board maritime with 64,500.

Licence exempt
Under regulations made the Secretary of State, or in future Ofcom, under section 1 of the WT Act 1949, some types of radio equipment are exempted from the requirement for a licence. The installation of such equipment is not a criminal offence, provided that the terms of the regulations are complied with. The current regulations are the Wireless Telegraphy (Exemption) Regulations 2003 (SI 2003 No.74), available at http://www.legislation.hmso.gov.uk/si/si2003/20030074.htm

LMDS
Local Multipoint Distribution Service

Marginal Spectrum
Spectrum that may be surplus to the requirements of a given licensee, owing to reasons of it being on the margins of frequency or geography, or being unused overnight.

MASTS
Mobile Assignment Technical System, an electronic assignment system currently under development for the RA.

MCA
Maritime and Coastguard Agency, also MCGA. Regulator of maritime and coastguard agency services.

Mesh radio
Broadband Fixed Wireless Access architecture that avoids the limitations of point-to-multi-point systems.

MMDS
Multichannel Mulitipoint Distribution Service: means of distributing television signals, through microwave from a single transmission point to multiple receiving points, often used as an alternative to cable-based television.

Mobile Satellite
A service between mobile earth stations and one or more space stations, possibly including feeder links in operation.

MoD
Ministry of Defence

MPT
The prefix for the numbering sequence for UK national type approval specifications.

Multiplexing
Transmitting two or more signals over a single channel.

NATO
North Atlantic Treaty Organisation

Neighbouring Licensees
Two or more adjacent licensees in terms of geography or frequency or both.

NPV
Net Present Value, the sum of a series of future discounted cashflows.

Ofcom
Office of Communications. Ofcom will take over the RA's responsibility for spectrum management in the UK in December 2003.

OFT
Office of Fair Trading, which is the main UK competition authority and has certain responsibilities under the Enterprise Act in relation to merger control

Oftel
Office of Telecommunications, which is the office of the Director General of Telecommunications, the current telecommunications regulator, whose functions will transfer to Ofcom on 29th December 2003.

Opportunity cost
The potential value of an asset in the next best alternative that is foregone by virtue of its actual use.

PAMR
Public Access Mobile Radio

PBR
Private Business Radio (previously known as Private Mobile Radio (PMR)) A private radio service installed and operated by businesses and public sector organisations to provide mobile communications for their own workforces. A base station is installed by each organisation on a suitable site providing local coverage, and used to send or receive short messages concerning the business of the organisation to, from or between, mobile units.

PFD
Power Flux Density

PMR
Private Mobile Radio (PMR), see PBR

Point-to-multipoint
Fixed link having at one end a multi-directional antenna for communication with a multiple users over a relatively small area.

Point-to-point
Fixed link, generally using highly directional antenna at each end, for communication between two fixed points.

Pooled frequencies
Frequencies used by multiple users, on a non-exclusive, shared basis (for example, maritime on-board communications frequencies). Users of on-board communications equipment can use a range of pooled frequencies, or channels, to communicate. The user will choose a channel on which to communicate and will switch to an alternative channel if that one is busy.

PPARC
Particle Physics and Astronomy Research Council

Primary Assignment
The initial allocation of spectrum by the regulator to the market.

Propagation
The transmission of radio waves. Propagation characteristics depend on frequency and are affected by the environmental conditions, such as terrain and atmospheric conditions, encountered on the path.

PSB
Public Service Broadcasting/Broadcaster

PSD
Power Spectral Density

RA
The Radiocommunications Agency: an executive agency of the Department of Trade and Industry, responsible for the management of most non-military spectrum in the UK and for representing the UK in relevant international bodies. The RA's functions will transfer to Ofcom on 29th December 2003.

Radio Authority
The regulatory body that oversees and licenses radio broadcasting in the UK, whose functions will transfer to Ofcom on 29th December 2003.

Radio-cameras
Apparatus used by programme-makers and organisers of special events.

Radio-microphones
Equipment used by programme-makers and organisers of special events.

Reconfiguration
The redefinition of a right to use spectrum, for example, by separating one licence into two, or amalgamating two licences which are adjacent in terms of geography or frequency.

Refarming
Migration from an outgoing to an incoming service on a particular range of spectrum.

Remote meter reading
The reading of meters from a distance using radio.

Rolling Term Licences
Licence's whose term of validity continues until notice is given a defined period in advance.

Roll-out requirements
Specific requirements relating to build or operation of radio network.

RSA
Recognised Spectrum Access

Safety of life services
Services provided by organisations who use radio spectrum to protect the lives of individuals, such as the emergency services.

Scanning Telemetry
National channels that are licensed to the water, electricity and gas companies.

Secondary Market
The market that is created once the initial allocation of spectrum has been made by the regulator.

Site Clearance
Permission to install or operate a radio transmitter at a particular site.

SME
Small or Medium Sized Enterprise.

SMO
Spectrum Management Organisation. An organisation that undertakes the administrative and technical management of part of the radio spectrum, usually limited to the identification of suitable assignments, record keeping, calculation of interference risks etc, and also the distribution of licences.

Software Radio
A type of technology that provides mechanisms to help deal with spectrum scarcity.

Spectrum Mask
A mechanism designed to define the right to transmit with a tradable licence.

Spectrum Registry
A central record of all licensees and all conditions associated with each licence established by Ofcom under section 170 of the Communications Act.

Spectrum tariff unit
An average tariff per MHz of spectrum used. This average tariff is set at 50 per cent of the marginal values on which it was based, therefore the licence fees were multiplied by a factor of two in the calculation.

Spectrum
A continuous range of frequencies of electromagnetic radiation (for example, radio waves).

T&D
Test and development.

TARBS
TARBS World TV Australia Pty. Ltd. An Australian-based pay TV and radio broadcaster targeting ethnic communities.

TDMA
Time Division Multiple Access

Telecommand
The use of telecommunications for the transmission of signals to initiate, modify or terminate functions of equipment at a distance.

Telemetry
The transmission of radio signals and coded data.

TETRA
Trans European Trunked Radio Access: A European Telecommunications Standards Institute (ETSI) standard for mobile radio, utilised by fleets of vehicles such as taxi cabs and emergency services e.g. police, fire services.

TETRA2
Trans European Trunked Radio Access Data Upgrade: An upgrade to the TETRA standard that provides additional functionality for data communications.

Trading Regulations
Regulations made under section 168 of the Communications Act to enact spectrum trading.

Trunked radio
A system in which users share or pool a number of radio channels. Frequencies are distributed by the system according to demand and traffic levels. Trunking can enhance spectrum efficiency in some circumstances.

UK Plan for Frequency Authorisation
A plan published by the RA, and in future by Ofcom, setting out (a) the frequencies that in relation to the UK have been allocated for particular purposes and are available for assignment and (b) the purposes for which the different frequencies have been allocated.

UMTS
Universal Mobile Telecommunications System – a third generation mobile standard.

Undue interference
Interference with any wireless telegraphy that is harmful, as provided by section 183 Communications Act 2003. This includes interference that creates dangers or risks of dangers to the functioning of any radiocommunications service designed for the purposes of navigation or safety services, or if the interference degrades obstructs or repeatedly interrupts authorised broadcasting or other wireless telegraphy.

Use it or lose it
A specification by the regulator that licensees should either effectively use their designated spectrum or face having their licence revoked.

UWB
Ultra Wide Band. A technology that spreads a signal thinly over a wide range of frequencies.

VHF
Very High Frequency (30 – 300 MHz)

VSAT
Very Small Aperture Terminal

Wireless LAN
Wireless Local Area Network

WT Acts
Wireless Telegraphy Act 1949 (as amended by the Wireless Telegraphy Act 1967) and Wireless Telegraphy Act 1998. These Acts are further amended by the Communications Act 2003. These Acts regulate the use of civil radio spectrum in the UK.

WT Act licences
Licences issued under the Wireless Telegraphy Act 1949 (as amended).

OF 15 (Nov 03)

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