Strategy for the future use of the Radio Spectrum in the UK
2002

Introduction by:

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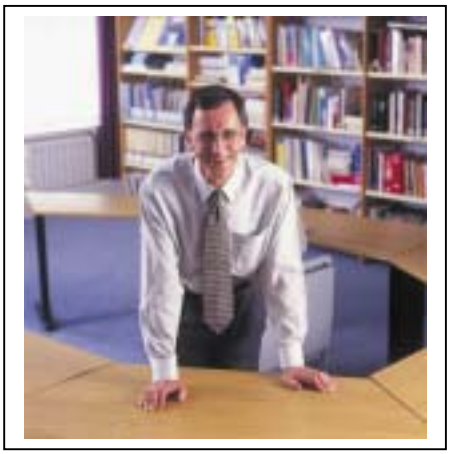

This, the sixth edition of the UK Spectrum Strategy, is published at a time when major changes to spectrum management are on the horizon. The Office of Communications Act 2002 establishing the new Office of Communications or OFCOM as a unified communications regulator received Royal Assent on 19 March. The draft bill setting out OFCOM's responsibilities in detail is expected to be published very soon. The Government has announced that, once the necessary substantive legislation is in place, the Agency's responsibilities for spectrum management will be carried out by this new body. The Government's White Paper: *A New Future for Communications*,[1] gave important assurances that OFCOM will be required to exercise its spectrum management functions in the interests of all, both inside and outside the communications sector. We are very much looking forward to our future as part of this powerful new independent regulator, although the process of transition will inevitably be complex.

In addition, the recently published report of the independent Review[2] of Radio Spectrum Management by Professor Martin Cave has set out a challenging agenda for the future of spectrum management, about which I have more to say below.

Whatever the future arrangements for managing the spectrum, that task will become ever more important as the pressures on this finite resource, both for traditional applications and exciting new ones, continue to grow. The creation of OFCOM reflects the recognition that, in an increasingly converged communications environment, traditional service demarcations can be a hindrance rather than a help to effective regulation. This is true of spectrum management, as technologies converge and, in consequence, service definitions become blurred and increasingly strained. In this Spectrum Strategy we are seeking to set out a flexible and forward-looking view of how we see spectrum management over the next few years and the major challenges facing us.

[1] A New Future for Communications; DTI/DCMS: December 2000
[2] Review of Spectrum Management :March 2002

Convergence in digital communications is giving rise to changes that are rapid and can be highly unpredictable. Strategic planning in these circumstances poses a considerable challenge. Any single prediction of the future is almost certain to prove wrong so, instead of relying on a single forecast, the Agency is using a set of four scenarios that cover a range of possible alternative futures. This is helping to produce a more robust Strategy based on a better understanding of the forces shaping the world of communications and their implications for spectrum usage and management.

My colleagues and I find, in our contacts with industry, other administrations and the European Commission that our Spectrum Strategy is highly regarded – certainly no other administration, to our knowledge, attempts to do anything directly comparable. However, we have been conscious – and have been reminded by our customers – that we have some way to go to make it a true strategy, rather than a compendium of useful information.

I believe that we have taken a further significant step in this direction with this edition. For the first time, we have outlined in some detail, in Chapter 1, our approach to managing the spectrum, the criteria we take into account, and what we see as the main issues and decisions facing us, across the whole of the spectrum, over the coming years.

We are also looking increasingly to broaden the scope of the Strategy. The Ministry of Defence has again provided a full and helpful contribution on the management of the military radio spectrum and there are also, for the first time, contributions from our colleagues in the Civil Aviation Authority and the Maritime and Coastguard Agency about the strategic priorities for the management of the aeronautical and maritime frequencies.

As the demands on the spectrum continue to increase, spectrum management is becoming ever more complex and involves a series of sometimes difficult trade-offs, which are discussed in Chapter 1. Each change in spectrum use creates opportunities but may also pose a threat to existing users. It follows that it may not always be possible to accommodate all potential spectrum users – though we will seek to do so as far as possible – and that not everyone will agree with our view of the future and our priorities. However, this Strategy is intended to be a living and evolving document, which is in no sense set in stone and will certainly continue to change.

Indeed, it may be that further change, particularly in the use of spectrum management tools, discussed in Chapter 7, will be required sooner rather than later, following the publication of the independent Review. While the Government's response to the Review will not be published until the summer, the Review's strong endorsement of the use of market mechanisms in spectrum management is in line with the way in which the Agency has been managing the spectrum since 1998 when spectrum pricing was introduced, though in some respects it challenges us to go further. Certainly spectrum trading, which the Government is committed to introduce, subject to the necessary legal changes and within a framework of appropriate safeguards, will require further development of our Strategy to take account of the new flexibility it will introduce to spectrum management.

In the meantime, this document sets out our current thinking essentially as a basis for consultation and debate. Its initial publication in draft last October was timed to coincide with the Agency's autumn programme of public roadshows and we are grateful for the comments received, which we have attempted to reflect, as far as possible, in this final version. But, given the pace of change, the Strategy will always need to remain a work in progress and we are already starting work on updating it. In particular, we now propose to publish on the Agency website updated versions of Appendix A, the annotated Frequency Order Table, at least twice yearly. Your comments on the Strategy will therefore continue to be welcome, both on where you agree and disagree with it. With your help we can make it even more effective as a basis for planning future growth and continued success.

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CHAPTER 1

THE MANAGEMENT OF THE RADIO SPECTRUM

1.1 WHY WE NEED A SPECTRUM STRATEGY

1.1.1 THE GROWING DEMAND FOR SPECTRUM

One of the Agency's key business objectives is to manage spectrum in accordance with a clear strategic plan, which:

- promotes, enterprise, innovation and competitiveness;
- makes full and appropriate use of all available spectrum management tools, including regulation, administrative spectrum pricing and, where suitable, auctions, in order to promote the best social and economic use of the radio spectrum; and
- carries forward innovative and progressive approaches to spectrum management.

The purpose of this Chapter is to explain how the Agency, on behalf of the UK Government, has put together its Spectrum Strategy, to provide an overview of the main elements in it and to invite comments on it (see 1.6).

2. It is unlikely that anyone reading this Strategy will need to be convinced about the importance of the radio spectrum and the need for its effective management. Spectrum management has always been important, but the complexity of the task has grown enormously in recent years with the proliferation both of traditional and entirely new radio-using services.

3. Relatively established uses, such as analogue sound broadcasting, have continued to expand: for example, commercial radio has seen rapid growth since 1990 and there are now over 250 stations. Society's growing appetite for mobility and the wish to make the maximum use of time such as that spent travelling, has led to a massive increase in demand for mobile radio-based applications for both private and business use. There are now 43 million mobile telephone users in the UK, compared to just 4 million in 1995. The demand for information-rich, high-bandwidth applications, such as video-conferencing and high speed internet access, is being met by broadband wireless applications, alongside other technologies including DSL and cable.

1.1.2 THE ECONOMIC VALUE OF THE SPECTRUM

4. The economic importance of the radio spectrum was vividly demonstrated by the outcome of the auction of licences for third generation (3G) mobile services in the spring of 2000. In the Government's view, the most important

aspect of the auction was that five service providers were chosen, from a strong field of 13 applicants, who will now have a powerful incentive to roll out networks quickly for the benefit of users.

5. The Agency's latest study on the economic impact of radio (*The Economic Impact of Radio: a Study Produced by the Radiocommunications Agency, February 2001*), which updated the previous 1995 and 1997 studies, has demonstrated that:

- the economic value of the radio industry (excluding civil aviation, defence and other public sector use of radio) is some £20 billion per annum at 2000 prices;
- broadcasting and public mobile radio together account for around three quarters of the estimated benefits;
- consumer benefits account for around 80% of the total value from the radio services surveyed, producer benefits and licence fees for the remaining 20%.

The full report, like the other Agency documents referred to in this Strategy, is available on the Agency's website at http://www.radio.gov.uk

1.1.3 THE SPECTRUM'S VALUE TO SOCIETY

6. As the range of radio applications, and the number of users, grows, the value of the spectrum to society continues to increase. Radio is the ideal means of meeting society's increasing demand for mobility. This is demonstrated in the massive growth of subscribers to the public mobile networks. There has also been a steady and continuing growth in demand for mobile radio services for business use, whether through self-provided systems or public networks.

7. Broadband radio services can provide fast data rates and "always on" connection to the Internet. They also offer the possibility of new sorts of services for consumers, businesses and schools, libraries, colleges and universities. The new 3G services will combine the advantages of mobility with the high data rates associated with broadband.

8. Although most public and media focus is now on the use of radio for relatively new mobile and/or broadband applications, there continues to be significant demand for traditional and non-commercial applications. One of the most important of these is defence, which uses around 30% of the radio spectrum. As explained in Chapter 3, despite the end of the cold war, the military requirement for spectrum remains very considerable. Indeed, the volatility of the world situation, and the diversity of potential threats, means that mobile military communications are now more vital than ever. Other public services, such as the police, fire, ambulance and coastguard are heavily dependent on radio communications and are increasingly looking to make use of the advantages which higher bandwidth mobile communications can offer, such as the ability to send live pictures from the scene of an incident.

9. The use of the radio spectrum is also very important from a cultural and social point of view. For example, public service television and sound broadcasting, remain very important users of radio spectrum, and also play a significant economic role, a situation which is certain to continue after analogue switchover, which is a major theme of this Strategy. Other significant users of the

radio spectrum include the aeronautical and maritime communities, the scientific community, individual hobby radio users, including radio amateurs, and the rapidly increasing number of applications based on short range wireless devices.

1.1.4 THE CHALLENGES FOR SPECTRUM MANAGEMENT

10. Until quite recently, spectrum management was relatively straightforward. The approach to licensing of most services was essentially first-come, first-served, as there was enough spectrum to accommodate most, if not all, potential users and permit adequate separation between potentially incompatible uses. That is no longer true. 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 275GHz and, in the UK, the spectrum is fully occupied, or at least committed, up to around 60GHz. The task of finding spectrum for new applications is therefore extremely difficult, not least because the technical characteristics of many services means that there are only relatively limited parts of the spectrum in which they can be accommodated, and this may involve complex sharing arrangements, the relocation of existing services and/or the replanning of bands.

11. Because of the long lead-time needed for the introduction of major new services, it is also necessary to plan a long way ahead, often without the certainty of knowing whether the new service will actually materialise. For example, the first global allocation for third generation mobile services, then known as FPLMTS (Future Public Land Mobile Telecommunications System), was agreed at the WARC 1992, that is about 10 years before the entry into commercial operation of the service. Of course, the preparatory work in ETSI, CEPT and ITU began considerably earlier than that.

12. Spectrum planning will also increasingly need to accommodate the effects of technological convergence as it blurs the boundaries between once distinct services such as broadcasting and telecommunications and begins to make the old allocation categories redundant. Other technological developments may also have profound implications for spectrum management. For example, it is claimed that the development of ultra wideband technology, which uses short pulse radio signals over a frequency range as wide as 7GHz, could eventually make the very concept of rigid spectrum allocations redundant, at least for some services. Other non-radio communications technologies, such as DSL and Powerline Technology, may also impact on spectrum management because of their potential to interfere with radio reception.

13. The task of strategic spectrum planning is thus becoming increasingly complicated. It must take account of the complex interaction between technical developments, market forces and social trends (for example, society's increasing concerns about health and the environment). It must also reflect international developments, as radio waves do not stop at national frontiers and most major radio services are now developed for a global, or at least a European market. It also needs to look a long way ahead, to take account of the timescale for the introduction of new services. The next section of this chapter describes how the Agency, on behalf of all UK interests, goes about developing the Spectrum Strategy.

1.2 HOW WE ARE DEVELOPING THE UK STRATEGY

1.2.1 CONSULTATION WITH USERS

14. It is our intention that the Strategy should, so far as possible, reflect the views of users and be developed in consultation with them, through the mechanisms explained below. As emphasised by the Chief Executive of the Radiocommunications Agency in his introduction, we seek and very much welcome comments on the Strategy and they will be taken into account in developing it further. This published version of the Strategy itself takes account of comments received on the final draft version, which was published on the Agency's website in October 2001.

15. The Strategy is compiled by the Agency in close collaboration with other Government Departments and public bodies responsible for spectrum management. The Agency regularly consults the industry, on an ad hoc basis on specific issues, and through a number of standing consultative committees such as the Mobile Services Committee, Fixed Links Consultative Committee and Satellite Consultative Committee, and through its Regional Customer Panels. The Agency is also working with the industry on longer-term projects: for example, the Private Business Systems Unit is currently working with the Federation of Communication Services (FCS) to develop a strategy for the PMR industry, which is reflected in Chapter 2.

16. In addition, it is the Agency's practice to consult widely, normally by issuing a consultation document, on any proposals for a significant change in spectrum management, such as the allocation of spectrum to a new service. Details of such proposals will also normally be placed on the Agency's website. Last but not least, the Agency consults users through its annual programme of public Roadshows in which the Chief Executive and Directors tour the UK to inform users about current developments and seek their views. The Spectrum Strategy was one of the main topics for the autumn 2001 Roadshow season.

1.2.2 INTERNATIONAL STUDIES

17. The international, and particularly the European dimension, is becoming increasingly important in strategic spectrum management. The current international spectrum management structures are outlined in Chapter 6. Discussions at World Radio Conferences (WRCs) and in the working groups and project teams of the ITU and CEPT are usually focused on identifying and meeting the spectrum needs of specific individual technologies and services.

18. In addition, however, CEPT is attempting to achieve a more co-ordinated and strategic approach to the planning and harmonisation of radio spectrum in Europe through its programme of Detailed Spectrum Investigations (DSI), which began in 1992. One of the outcomes of the DSI process is production of a European Common Frequency Allocation Table, covering major utilisations of frequency bands. It is intended that this table should be adopted by administrations by 2008.

19. The DSI process is conducted by the European Radiocommunications Office (ERO) in consultation with administrations, industry and users. The most recent phase of this exercise, DSI Phase III, covering the frequency range 862-3400MHz, was begun in 1998 and concluded in March 2001, when the ERC formally adopted its response to the Report's recommendations. The UK Government made a substantial input into the DSI III and the final report's recommendations were very much in line with our priorities and are reflected in the development of this Strategy. The report, together with all related documentation and contributions to DSI Phase III may be found on the ERO website at http://www.ero.dk/.

1.2.3 THE SPECTRUM MANAGEMENT ADVISORY GROUP (SMAG)

20. The Spectrum Management Advisory Group (SMAG) also provides an important input to the UK's spectrum strategy. SMAG is a non-departmental public body (NDPB) set up in 1998 to provide independent strategic advice to Ministers and the Agency on issues relating to the management of the UK radio spectrum. Its members represent the whole range of interests in relation to the radio spectrum including service providers, manufacturers and consumers. Current members are listed at Appendix C.

21. SMAG sets its own work programme but works closely with the Agency, whose Chief Executive is a member, as is his opposite number at the MoD. In many cases SMAG will take the initiative in examining a spectrum management issue which it believes to have strategic significance. In other cases, it may be asked by Ministers or the Agency for its view on a particular issue. In the pursuit of its remit, SMAG may commission independent research, or invite industry representatives to attend its meetings. SMAG has also held public consultation events, most recently on the 5GHz band.

22. Issues considered by SMAG over the last year have included the management of the licence-exempt 2.4GHz band, the development of wireless home area networks, the transition from analogue to digital broadcasting and the potential for licence-exempt services in the 5GHz band. SMAG has also considered the future demand for major areas of spectrum use, such as public mobile, fixed links and satellite. More details of SMAG's work are included in its latest Annual Report which is available on the SMAG website at www.smag.gov.uk

1.2.4 CO-ORDINATION WITHIN GOVERNMENT

23. The Agency has overall responsibility for the management of the civil radio spectrum. The Ministry of Defence (MoD) is responsible for the management of the military spectrum (around 30% of the total). A number of other Government departments, public bodies and regulators have a major involvement in spectrum management. These include the Department for Culture, Media and Sport (DCMS), which has policy responsibility for broadcasting; the Independent Television Commission (ITC) and the Radio Authority (RAu) which deal with the regulation and planning of commercial television services and commercial radio; the BBC, which is responsible for planning its own services; OFTEL, which is responsible for the regulation of telecommunications; the Department of

Transport, Local Government and the Regions (DTLR), whose Maritime and Coastguard Agency (MCA) is responsible for the management of maritime radio services; the Civil Aviation Authority (CAA), responsible for the management of aeronautical frequencies; the Home Office and Scottish Executive, which is responsible for the detailed management of the frequency requirements of the police, fire and some other services, and the Particle Physics and Astronomy Research Council (PPARC), which has a major interest in policy on radioastronomy and space services.

24. Strategic spectrum management issues which affect the interest of more than one department are considered by the United Kingdom Spectrum Strategy Committee (UKSSC), a Cabinet Office committee jointly chaired by the Chief Executive of the Agency and his MoD opposite number.

1.2.5 DEMAND STUDIES

25. The Agency needs to balance competing demands for the finite amount of spectrum available. To this end, the Agency from time to time commissions research, including demand studies, in relation to specific services for frequency bands. Demand studies consider the most likely political and macro-economic events, together with likely future economic relationships. The Agency uses these to estimate

- underlying economic demand for radio services;
- the amount of spectrum required to deliver these service levels;
- the amount of spectrum likely to be demanded by the whole service area; and
- relative future demand and amount of spectrum allocated to particular uses.

1.2.6 MONITORING

26 The Agency undertakes systematic monitoring of all frequency bands on a national basis and is investing heavily in automated Unattended Monitoring Systems. Monitoring of current spectrum use provides a valuable objective input to the spectrum management process and will increasingly supplement the information available from demand studies. Information on spectrum occupancy and congestion informs the detailed frequency assignment, licensing and spectrum pricing processes, as well as strategic decisions on frequency allocation.

1.2.7 SCENARIO PLANNING

27. Demand studies are a valuable input to spectrum strategy. They are based on a single ‘most likely outcome’ and are most useful in the near future where uncertainty is relatively low and manageable. However, the communications environment is characterised by rapid and unpredictable change. Looking further ahead to the medium/long term, uncertainty is greater. It is necessary to take account of a full range of political, environmental, social and technical factors and consider a broader range of possibilities. The Agency has therefore begun to use scenario planning to complement demand studies.

28. Scenarios provide a range of alternative, but equally plausible, visions of the future and so provide a more robust and insightful basis for longer term strategy. They provide a better understanding of a complex and uncertain environment and the drivers of change. Events can be monitored and compared to the timelines for the scenarios in order to provide early warning of future trends and the need to change strategy.

29. In 1999, the Agency commissioned consultants to generate a set of four scenarios for the Agency to 'map the future' of convergence and spectrum management for the next decade. These were based on a programme of interviews with business and other key players and a two-day workshop in January 2000 with participants from across the communications industry, Government agencies and academia.

30. The scenarios are based on four alternative visions of the future of convergence.

- *Internet Convergence*. Telecommunications, computing, entertainment and information are delivered over the Internet, which is part of the fabric of everyday life and the basis for interactive television. Strong brands are highly prized. Value chains are shaken up. Choice and customising abound.

- *Digital Islands*. Diversity continues but in closed community networks. Consumers reject 'excessive' choice on the Internet, which is seen as the option of last resort, and are attracted instead to the security and convenience of 'walled gardens', which are entered through trusted portals and interactive digital television.

- *Total Mobility*. Everything is untethered. Lifestyle and working habits mean users value the convenience and personalisation of mobile communications. Mobile phones rather than PCs are the way people access the Internet. There is a wide range of service providers, some virtual (ie provided over someone else's physical infrastructure).

- *Broadband Revolution*. Wireline speeds and capacity revolutionise broadband communications and entertainment. Only optical fibre, supplemented by Fixed Wireless Access radio applications, can meet ever-increasing demand for bandwidth for communication and entertainment, for example virtual reality and networked interactive games. Environmental and health concerns constrain mobile networks and service development and encourage telecommuting from broadband-enabled homes.

31. In January 2001, the Agency reran the workshop to reassess and revalidate the scenarios in the light of developments since the original report. Highlights included the following.

- Business models will focus on persuading customers to pay for content that is personalised and relevant. Convergence of Internet, mobile services and media will generate new excitement. Confidence in intellectual property protection and payment systems by content owners and consumers will be critical.

- The problems of today's Internet - lack of security, privacy, quality of service, capacity, ease of use - are real and need to be addressed.

- The market alone will not bridge the 'digital divide'. Government involvement in creating ubiquitous infrastructure was seen as crucial.

- Regulation has an important role to play in promoting open standards and competition and managing spectrum.

- Compared to a year ago, there was heightened concern over viability of new services and recognition that digital convergence may take longer than expected.

However, overall, optimism remained that new services will be adopted and a converged environment emerge by the end of the decade.

32. Reports of the 2000 and 2001 Workshops have been published on the Agency's website.

33. The scenarios are not predictions. Nor are they mutually exclusive so they are not regarded as options between which the Agency needs to choose. They can co-exist and interact in a complex and dynamic way with relative dominance altering over time. Each scenario implies a different pattern of demand for spectrum as illustrated in the following table.

Differences Between Scenarios in Terms of Spectrum Demand

	Scenario A Internet Convergence	Scenario B Digital Islands	Scenario C Total Mobility	Scenario D Broadband Revolution
Additional spectrum relative to now for				
- Wide-area mobile	++	+	+++	+
- Short-range radio	++	+	++	+++
- Fixed wireless access	+	++	+++	++
- Digital video broadcasting	+	++	0	–
Speed of broadcasting/telecoms convergence	Moderate	Slow	Moderate	Fast
Speed of fixed/mobile integration	Slow	Slow	Fast	Fast

Key:

–	Less spectrum needed
0	Same spectrum needed
+	Some increase in spectrum needed
++	Modest increase in spectrum needed
+++	Substantial increase in spectrum needed

34. Some elements, such as the increase in demand for wide-area mobile, are common to one or more scenarios albeit to a differing degree. Others show significant differences, notably for video broadcasting. This underlines the importance of monitoring developments so that strategy can be adjusted. A key conclusion that may be drawn is the importance of flexibility so that spectrum

assignments and allocations can respond to rapid change in technology and markets. This reinforces the rationale for the Agency's policy of making greater use of market mechanisms, such as pricing and trading as described in later chapters. It also indicates that internationally agreed service definitions should be as unrestrictive and as broadly drawn as possible so as to avoid imposing artificial barriers to convergence.

35. The Agency hosted a workshop for public sector spectrum managers, from the Government Departments involved in spectrum management, OFTEL and the ITC in April 2001. The aim of the workshop was to draw out relevant lessons from the convergence work for the development of the Spectrum Strategy. It is the Agency's intention that the Spectrum Strategy will take full account of this work and the information which it will provide. This process has begun with this edition but will be taken further in the future. The Agency has in hand a study for an advanced project to provide a comprehensive scenario-based planning tool and database.

1.3 SOME KEY SPECTRUM MANAGEMENT ISSUES

36. The choice of appropriate spectrum management tools can have a vital role to play in ensuring that users have an incentive to make the most efficient use of the spectrum assigned to them and, in some cases, in choosing those who will provide services. In the light of the growing pressures on the spectrum, and the need to ensure its optimal use, the Agency has been at the forefront of moves towards the use of more market-based spectrum management tools to complement regulation, as described in more detail in Chapter 6. The Wireless Telegraphy Act 1998 marked a major change in spectrum management through the introduction of spectrum pricing and auctions. The Agency foresees further moves in this direction, through the continuing progressive roll-out of administrative incentive pricing and auctions (see Chapter 6). It is also preparing for the introduction of spectrum trading, subject to the necessary legislative changes.

37. The deployment of these tools, and the economic principles which should guide their use, are the main focus of the independent Review of Radio Spectrum Management, led by Professor Martin Cave. The Review's Report, published in March 2002, has made a number of recommendations about ways in which it may be possible to go further in using market-based spectrum management tools to provide an incentive for all spectrum users to take into account the opportunity cost of the spectrum they are using and so to promote optimal use of the finite spectrum resource. The Government will publish its response by the summer and its conclusions will feed into the spectrum provisions of the Communications Bill, as well as to further editions of this Spectrum Strategy and the future management of the radio spectrum.

38. Chapter 6 of this Strategy outlines the spectrum management tools which are available to the Agency and how these are currently being used. The purpose of this part of this Chapter is to outline the main considerations which the Agency seeks to take into account in its spectrum allocation policy.

39. As stated at the beginning of this Chapter, the Agency aims to manage the spectrum to promote, enterprise, innovation and competitiveness; making full and appropriate use of all available spectrum management tools to promote the best social and economic use of the spectrum. Subject to that, the Agency seeks to accommodate all who wish to use the spectrum, to the extent that this can be done without interfering with other users and in accordance with international obligations. As explained in 1.1 above, this task used to be relatively simple when demand was less and change was less rapid but is now much more complex because of the growth in demand and the proliferation of spectrum-using technologies. As the pressures on the spectrum continue to grow, allocation policy increasingly entails difficult choices between alternative users or kinds of use. Some of the most important of these are discussed below.

1.3.1 COMMERCIAL OR NON-COMMERCIAL ?

40. One of the most difficult choices is between commercial and non-commercial (including governmental and defence) use. The 3G auction and the Agency's economic impact studies have dramatically demonstrated the economic value of parts of the radio spectrum for commercial services. This is itself a reflection of the value which end users attach to the services which the spectrum can provide, in particular, those which offer the benefits of mobility combined with high bandwidth.

41. However, many non-commercial radio uses are vital to our national well-being, though their value may be harder to express in economic terms. It is important, as Professor Cave's report agrees, that spectrum should continue to be made available to these uses which include military use of radio (described in Chapter 3) for national defence, use of mobile radio by the police, fire and ambulance services, to protect life and property, safety critical use of radio by the civil aviation and maritime communities, and the many cultural, educational and scientific uses of radio, including public service broadcasting, although they should also be subject to effective incentives to use spectrum efficiently.

42. For much of the 20th Century, government, and particularly military use was largely predominant. However, with the growth in demand for commercial services, the proportion of the spectrum allocated to Government services has come under increasing pressure. Many commercial services, such as GSM cellular networks, use spectrum which was once wholly or predominantly allocated for military use and there will be continuing pressure for this trend to continue.

43. The Government's approach to the trade-off between civil and military use is to seek to ensure that military use of spectrum is rigorously justified taking into account continuing military needs, civil requirements and, where applicable, international constraints. Where possible, it is the Government's aim to look for reallocation of spectrum to civil services, or increased sharing. Over time, a considerable amount of military spectrum has been reallocated for civil use. For example public mobile services in the 900MHz band operate in what was once military spectrum. Opportunities for this kind of reallocation continue to be explored by the Agency and the MoD, as is currently being done to make available additional spectrum for TETRA in the 410-430MHz band. Sometimes (as in the case of GSM) this reallocation may be on the basis that spectrum is

made available to civil users on a pre-emptive basis and can revert to military use in the event of a military emergency. This may be possible since military demands, while requiring absolute priority in a potential military emergency, will often be less pressing in peacetime.

44. The Government also seeks to ensure that public services make the most efficient use of the spectrum which is allocated to them, for example by adopting modern, spectrum-efficient technologies where possible. An example of this is the planned adoption by the police and some other emergency services of new digital TETRA technologies in the 380-400MHz band, under the PSRCS (described in Chapter 2: Private Mobile Radio). This should ensure not only that the police services themselves have more efficient radio services with wider functionality, but will permit the re-planning and re-use of the frequency bands previously occupied by police analogue mobile radio services.

45. Public services are also being exposed to the disciplines of spectrum pricing. Those services, including defence, that use spectrum which could, if released, be used by commercial services now pay for the spectrum they use on a comparable basis to private sector users.

1.3.2 SHARED OR EXCLUSIVE SPECTRUM ?

46. Some users require exclusive use of spectrum - for example, the public mobile operators, because of the nationwide scale of their operations and the need to maintain a minimum quality of service to their customers. This can sometimes lead to greater spectrum efficiency, as users who have major blocks of spectrum under their control can make more intensive use of it by dynamically reconfiguring their networks in response to demand.

47. In some cases, however, the efficiency of use of spectrum can be significantly increased by sharing. Sometimes, sharing will be possible between radio services because the technical and operational characteristics of transmitters in one service can be managed so that they will not interfere with users of the other service in the same band. In other cases, sharing may be possible on a geographical basis, for example where the major demand for a particular service is limited to areas of high population density and other services can use the same frequencies outside these areas. Some military use is also limited to remote parts of the country, permitting civil sharing of the same frequencies in other areas.

48. Much of the work of the Agency's Radio Technology Compatibility Group (see Chapter 8) is concerned with establishing the technical parameters relating to sharing of spectrum, particularly in relation to new and emerging radio systems and their interaction with existing services. The CEPT's Spectrum Engineering Working Group also has an extensive programme of work, much of which is concerned with establishing the possibilities of sharing between different services in the same or adjacent bands.

1.3.3 SATELLITE OR TERRESTRIAL USE ?

49. Another difficult trade-off which the spectrum manager must consider is to balance the sometimes competing claims of terrestrial and satellite services in the same spectrum. Satellite services have a number of attractions in terms of their capacity to provide global or regional coverage, to cover areas of difficult terrain, where terrestrial services would be difficult or expensive to roll out, and their ability to carry a wide range of different types of services, including high bandwidth services. Once the initial investment has been made they can also be rolled out more quickly than equivalent terrestrial systems. For services which require global coverage, such as certain types of navigation services, they offer unique advantages.

50. On the other hand, the upfront costs associated with building and rolling out satellite networks are normally very substantial. International frequency co-ordination can be a very lengthy process and the scope for frequency re-use can be extremely limited, especially where the receiving antennas of the ground terminals have little if any angular discrimination (for example in the mobile-satellite service). Satellite delivery is also normally not well suited for general mobile reception. Thus the commercial viability of satellite networks can be uncertain, particularly where they are in direct competition with, rather than complementary to, terrestrial telecommunication networks. While satellite services can be very attractive in some parts of the world and especially for geographically large countries, the trend in Europe in the past has been to support new allocations for spectrum for satellite services which will offer global coverage, such as Galileo, or for systems which aim to meet specific highly technical (e.g. scientific) needs. Where satellite services have been in direct competition for spectrum with terrestrial services, the emphasis has been on minimising the constraints imposed by satellite services on terrestrial services.

51. This issue will continue to be a major challenge in the future. Where allocations to satellite services already exist, we will encourage their use, taking into account the needs of any other services to which the band in question is allocated. The Agency has established clear criteria which have to be met before the UK will submit a satellite network for international co-ordination in accordance with the ITU procedures. We are committed to trying to resolve the major problem of the time delays associated with this process (the so-called satellite filing backlog) and the Agency has provided the chairman of the international action group on this issue. Where proposals arise for new satellite allocations, or improvements in the status of existing allocations, these will almost inevitably be in direct competition with terrestrial systems. Given the pressure in the UK on terrestrial service allocations, and uncertainty, in the light of experience, about whether these new satellite services will ultimately materialise, we will adopt a cautious approach and give priority to protecting the terrestrial service interests. It is very difficult to envisage being able to make any new spectrum available on an exclusive basis for satellite services. Sharing options will normally be considered, as is the norm for the fixed-satellite and fixed terrestrial services. As the technical and operational characteristics of these two services develop, it may be necessary to examine the possibility of band partitioning, although in general this has not been favoured. This approach has, however, been adopted by CEPT in relation to the 28 GHz band which has been partitioned between fixed and

satellite services. Whatever the outcome, it is desirable that the arrangements are flexible and fair.

1.3.4 LICENSED OR LICENCE-EXEMPT SPECTRUM ?

52. Effective spectrum management can also involve difficult decisions on the balance between the spectrum to be allocated to licensed and licence-exempt services. Licence-exemption can offer significant advantages for users, in particular the cost savings and convenience resulting from the possibility of using radio equipment without the need to apply for a Wireless Telegraphy Act Licence and a specific spectrum assignment. This offers obvious advantages in relation to mass-produced items for domestic use, such as remote controls or garage-door openers, for which individual licensing would not be feasible, and for private users or small businesses who wish to use radio equipment in a domestic or office setting. The Agency has made a number of bands available on a licence-exempt basis and these are set out in Exemption Regulations which are reviewed periodically. Most of the current bands for licence exempt use are listed in Chapter 2; Short Range Devices and a table giving the UK radio Interface requirements is in Appendix I.

53. In order that the use of these bands remains viable, and that users of licensed equipment in adjacent bands do not suffer unacceptable levels of interference, it is necessary to impose certain minimum technical parameters for SRDs. These are referred to in the appropriate UK Interface Requirements (see Appendix I).

54. Licence exempt bands are not centrally co-ordinated and interference between devices on the same frequency is limited to some extent by the power limitations imposed in the Interface Requirements. The self-evident limitation of uncoordinated licence-exempt bands is that there can be no guarantee of any degree of spectrum quality for users in any given area, who must expect that on occasions there will be instances of co-channel interference. Moreover, the Agency is aware that short range low power devices for mass market applications invariably have limited receiver performance in terms of poor selectivity. This renders them liable in particular to interference from generally higher power devices operating in adjacent licensed bands.

55. As the number of short range wireless applications increases, it is possible that, in some areas of dense use, the noise floor will increase and new techniques may be required to ameliorate the effects of interference. Such techniques are available in the form of technologies to improve channel access generally through dynamic frequency selection and power control. Nevertheless, the Agency is aware that under extreme conditions there will be limitations through possible congestion and intends to work with industry to ensure that these are understood by potential users, particularly in regard to the unprotected nature of deregulated spectrum.

56. Another potential difficulty, from a spectrum management point of view, is that the process of deregulating a band is very difficult to reverse, as there will be no record of the equipment used in the band and no way of requiring its use to be discontinued other than the slow process of withdrawing the relevant UK Interface

Requirement (see Chapter 7) and waiting for the items in use to reach the end of their life.

57. The use of spectrum without a licence is currently restricted to private applications, that is self-provided systems for the user's own use. An important issue, which the Agency is currently considering, is whether and, if so, on what terms, the use of public radio systems provided commercially for use by third parties, should be permitted in the licence-exempt bands. There are strong arguments for amending the existing Exemption Regulations to permit the provision of, for example, public access Wireless LANs to meet the need for very short-range broadband extensions to public networks.

58. However, there are a number of technical, economic and competition issues that need to be considered before any relaxation of current Exemption Regulations to allow public access services is agreed. These were identified in a national Consultation[3] published by the Agency in October 2001. The Consultation closed in February 2002 and attracted over fifty responses. These are being studied before recommendations are prepared for Ministerial approval.

59. The following sections set our how the Agency is seeking to apply the principles set out above to its spectrum planning.

1.4 SPECTRUM ALLOCATION PRIORITIES

60. This section sets out, in general terms, what the Agency sees as the priorities in terms of future frequency allocations, over the period to 2010. These priorities reflect the Agency's ongoing dialogue with industry, international discussions, and the conclusions of the scenario planning exercise, outlined in Chapter 1.2.

61. These are set out as the basis for consultation, recognising that currently unforeseeable changes may require major changes to our policy over the years, and are certain to require regular adjustments to it. **We invite and very much welcome the comments of radio users, manufacturers and all readers of the Strategy on these proposals (see 1.6).**

62. The Agency believes that it will be necessary to continue to seek to provide spectrum for all categories of current use. Nevertheless, there are three areas in which we anticipate particularly strong growth in demand for spectrum, which we will need to try to accommodate, over the next 10 years.

1.4.1 MOBILE SERVICES

63. Perhaps the outstanding feature of spectrum use over the last 10 years has been the massive increase in demand for mobile services. The provision of public mobile services only began in the UK in the mid-1980s but current estimates put the number of cellular subscribers at around 43 million or approximately 70% of the UK population. Although market growth, measured by

[3] Consultation on the use of licence-exempt spectrum for the provision of public telecommunication services: October 2001

number of subscribers, will inevitably flatten off, we estimate that there will be a continuing growth in demand for mobile spectrum, as users increasingly seek the additional functionality that higher bandwidth mobile applications can provide and as the possibilities of machine–to–machine communication continue to increase. All the convergence scenarios described above posit increases in demand for mobile services, though this would be most marked under Total Mobility.

64. A major priority for the Agency, therefore, will continue to be provision of spectrum for public mobile services. The evolution from first generation analogue services to GSM digital is now complete and it is expected that demand for GSM services, including enhanced service offerings such as GPRS, will remain strong for the foreseeable future. GSM spectrum is therefore likely to be used intensively over the next 5 years, probably longer, though it is unlikely that more spectrum will be made available for GSM use.

65. 140MHz of spectrum for Third Generation 3G (IMT2000) services has been assigned following the auction in the spring of 2000 (together with 15MHz of unpaired spectrum, the use of which is considered in the Agency's Consultation Document on Licence-Exempt Spectrum - see Chapter 2.16; Short Range and Licence Exempt Devices). Indications are that commercial services will be launched in these frequencies in the latter half of 2002 or early 2003. The situation in the longer term remains unclear. The Total Mobility scenario implies that a total of at least 2x240MHz of terrestrial spectrum will be required by the year 2010. WRC2000 identified an additional 190MHz of spectrum, on a global basis, for IMT2000 which, if made available, should go a long way towards meeting this demand.

66. The Agency is now beginning to plan for the provision of additional spectrum for 3G services in these bands, for instance by seeking alternative frequencies for current users, such as programme-making. However, no final decisions on the timing of future spectrum availability will be taken until the roll out of 3G services begins and it becomes possible to make more informed estimates of the level of future demand. As explained in Chapter 2.13, it is likely that the Government will wish to consider the longer-term use of the GSM bands, including their possible refarming to 3G use, alongside proposals for further release of spectrum for 3G in the WRC extension bands.

67. Another key issue which the Government will need to consider is how the UHF frequency bands which are currently used for analogue and digital television broadcasting should be used by digital TV once the switchover to digital is completed and analogue transmissions cease. The draft Digital Television Action Plan published on 12 October 2001 sets out a timetable for taking this work forward and the DTI and DCMS issued a consultation document on the spectrum planning issues: *Digital Television; The Principles for Spectrum Planning,* in December 2001. This will help to determine the spectrum requirements for digital TV after switchover and will provide an important input for the Government as it assesses the demands on the spectrum for a range of potential uses including programme-making and mobile services. As explained in Chapter 2.4, the Government is committed to ensuring that sufficient spectrum is available to continue to deliver its objectives for public service broadcasting and to give current pay TV services as least as much coverage as they have now. However,

as explained in the consultation document, the process of spectrum replanning is likely to release a number of channels for a range of possible alternative uses, which could be broadcasting or non-broadcasting purposes.

68. In addition, the Agency will continue to seek to make available spectrum for self-provided PMR mobile services for which demand seems likely to remain high in the medium term. We will, in co-operation with MoD, continue to make more spectrum available for TETRA by reassigning military frequencies in the 410-430MHz band. The Agency will also seek to make more spectrum available for PMR services by replanning the 450-470MHz band and by encouraging emergency service users to move to the Public Safety Radio Communication Service (PSRCS), the national roll-out of which is planned to be completed by 2004. This should permit the provision of additional spectrum in the 450-470MHz band for private users.

1.4.2 FIXED LINKS AND FIXED WIRELESS ACCESS

69. The Agency believes that demand for fixed links will continue at a high level and that demand for fixed wireless access, including broadband fixed wireless access, will show further growth between now and 2010.

70. The high level of demand for fixed links is in part linked to the growth in mobile services as increasing numbers of fixed links will be needed to provide infrastructure support for mobile networks, including 3G networks. There is already a trend for increasing demand for fixed links, particularly in the higher frequency bands such as 23, 25 and 38GHz, and this is likely to continue as 3G networks are rolled out.

71. In parallel, the Agency anticipates increased demand for the provision of point to multipoint fixed wireless access (FWA) services, including broadband FWA, in support of the objectives set out in *UK online: the broadband future*. The Broadband Revolution scenario suggests that the next 10 years will see a marked increase in society's demands for high capacity fixed networks to provide both business and leisure applications. This is also anticipated under the Total Mobility scenario as the use of mobile devices becomes ubiquitous for users on the move, while those same users, in the home or office, will seek the extra functionality of very high bandwidth fixed services. Under this scenario there will also be a continuing growth in demand for fixed links to provide infrastructure for mobile networks.

72. The Agency's recently completed study of the demand for FWA services shows that it will continue to increase over the foreseeable future and the Agency is considering the options for making available additional spectrum, in the short or medium term, in a range of frequencies from 2GHz to 40GHz, as described in Chapter 2.9.

1.4.3 SHORT RANGE RADIO LINKS

73. A major feature of the last few years has been the development of wireless local area networks (WLANs) able to provide communication between many types of mobile and nomadic terminals. These services have the potential to revolutionise provision of IT services to business and domestic premises by

improving access for a wide range of applications. They may be used to offer fixed and mobile/nomadic services complementing existing methods of providing high bandwidth connections for a range of applications in home, office, museums and educational establishments. WLANs currently operate at 2.4GHz and 5GHz. The 2.4GHz band is an established band for a wide range of licence-exempt short range devices including WLANs. These use spread spectrum technology to provide wireless connections indoors between various devices and outdoors to provide access to schools and colleges requiring broadband services. 5GHz WLAN technology will provide higher data rates and is expected to enable a range of new services including educational networks, interactive museum guides, distributed database services and streaming broadcasting signals within the home.

74. These services, which are provided on a licence-exempt basis, offer major advantages to users. The Agency wishes to ensure that its spectrum management policies facilitate the exploitation of these exciting technologies to the greatest extent possible. As explained in Chapter 2, the Agency has recently concluded a consultation on a possible relaxation of the current regulatory regime, to permit the provision of public telecommunication services in licence-exempt spectrum. Although the scope of any changes has not yet been decided, any amendment of the Exemption Regulations could have important implications for the range of services currently provided in licence-exempt spectrum, and in particular in the 5GHz band.

1.4.4 OTHER ISSUES

75. In the Agency's view, the three areas outlined above represent the major likely areas of growth for spectrum demand over the next 10 years, which the Agency will seek to meet. However, it is clear that there will continue to be very substantial demand for spectrum in many other areas for the foreseeable future.

76. The most significant spectrum users will continue to include defence (whose spectrum requirements are discussed separately in Chapter 3) and television and sound broadcasting. Other major users will continue to be the aeronautical, maritime and science services. It will also be necessary to continue to accommodate the needs of smaller-scale users such as the amateur and CB communities. Our proposals for all these services are outlined in Chapter 2 and Appendix A. As emphasised at the head of this section, the views of all categories of radio users on the proposals in this document will be extremely welcome.

1.5 SUMMARY OF KEY SPECTRUM STRATEGY ISSUES

77. This section aims to give a brief overview of the main proposals on frequency use in this Strategy. It should be read in conjunction with the entries on specific services in Chapter 2 and the detailed table of frequency use in Appendix A.

0-1GHz:

- No major changes foreseen in use of VLF, LF,HF and MF frequencies (though interesting developments in digital transmission may well figure in future editions of the Strategy);
- Continuing strong demand for analogue sound broadcasting in the VHF(FM) band;
- Development of VHF digital sound broadcasting services;
- Continued intensive use of GSM frequencies at 900MHz;
- Government to take forward planning for UHF TV digital switchover and for use of additional channels released, including preparations for 2005 Regional Radiocommunications Conference to replan the VHF and UHF broadcasting bands;
- CT0 and CT2 cordless applications to be phased out by 2005;
- MoD to make further spectrum available for TETRA in 410-430MHz band;
- Emergency services to migrate to PSRCS by 2004, releasing spectrum in 450-470MHz band;
- Replanning of 450-470MHz band to be carried forward;
- Roll out of GSM-R to begin in 2002 and be completed by 2006;
- Review of 863MHz band for SRDs;
- Withdrawal of SRDs at 888-889MHz.

1-3GHz:

- Continued intensive use of GSM frequencies at 1800MHz;
- Roll-out of 3G services at 2GHz in 2002-5;
- Migration of programme-making links at 2.5GHz;
- Longer-term rollout of 3G at 2.5GHz;
- Consultation on 2G-3G refarming;
- Possible reassignment of FWA spectrum at 2GHz;
- Removal of 1.5GHz fixed links to be completed by 2007;
- Removal of existing troposcatter fixed links;
- Provision of spectrum at 1.5GHz for use by DAB using Eureka 147 technology.

3-10GHz:

- Continued priority for radar use at 2.7-3.4GHz and 9.2-9.5GHz in medium term;
- Award of FWA licences at 3.4GHz including band re-alignment;
- Consultation on provision of public services in licence-exempt spectrum at 5GHz;
- Possible issue of FWA licence at 10GHz;
- Review of Government radar use 2001-2.

10-30GHz:

- Award of further BFWA licences at 28 GHz;

- Continued provision of fixed links at higher frequencies, including 23 and 25GHz;
- Consultation on licensing of Broadcasting Satellite Service (BSS) frequencies at the 33.5 degrees west orbital position.

Over 30GHz:

- Licensing of MWS systems at 40.5-43.5GHz;
- Exploitation of new FS frequency bands above 30GHz including 32, 52, and 55 GHz.

1.6 COMMENTS

78. The Agency welcomes and encourages comments on this Strategy Document from interested parties and will take these into account in the continued development of the Strategy. Please contact by e-mail, fax, post or telephone:

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CHAPTER 2

DEVELOPMENTS IN RADIOCOMMUNICATIONS

2.1 AMATEUR AND AMATEUR SATELLITE.

CURRENT SPECTRUM USE

A range of frequencies from 72 kHz to 250 GHz, mostly shared with other services.

CURRENT ISSUES

Use of Amateur Radio has been experiencing a slight decline for some time now. The number of licensees has fallen from 61,410 in 1995 to 57,381 in 2001. This has been attributed to developments such as the widespread use of mobile phones and, particularly, the Internet, which gives users a means of establishing world-wide communications without the need for specialised technical training or knowledge. The perceived difficulty of the Radio Amateurs Examination (RAE) serves only to exacerbate the situation.

To stimulate interest in this rewarding hobby, the Agency has worked closely with the Radio Society of Great Britain (RSGB) to develop the Foundation Licence. This new licence class is intended to provide newcomers to Amateur Radio with an opportunity to participate in the hobby without the need for extensive technical training. The syllabus and licence privileges were finalised in late 2001 and the new licence class launched in January 2002. The Foundation Licence is proving extremely popular, with over 2400 new licences issued since its launch. It is particularly pleasing that of these new licensees, 700 or so are under 21 years of age. Thus it is hoped that this licence will prove effective in rejuvenating interest in the hobby and provide a useful avenue to develop skills in practical radio electronics. Together with the two traditional licence classes, the Intermediate and Full Licence, it forms a suite of amateur radio licences which the Agency hopes will cater for the diverse range of interests and expertise of the amateur enthusiast.

FUTURE STRATEGY

The Agency is currently looking into the following developments in amateur radio:

i) the possible installation and use by radio amateurs of telemetry and telecommand equipment on-board unmanned aircraft, including rockets and balloons. The bands under consideration are: 50–51 MHz; 144–146 MHz; and 24–24.05 GHz;

ii) the possibility of permitting the use of spread spectrum techniques in the amateur service; and

iii) the implementation of the WRC-2000 decision relating to the use of frequencies above 76 GHz for radio amateur use.

2.2 CITIZENS BAND RADIO (CB).

CURRENT SPECTRUM USE

There are two sets of frequency bands allocated to Citizens' Band (CB) in the UK, they are: 26.965–27.405 MHz (known as the CEPT Band) and 27.601–27.991 MHz (known as the UK Band). There are 40 channels within each band.

CURRENT ISSUES

Over the period 1995 to 2001, the number of licences on issue has declined from 52,047 to 27,028. It is hoped that with the introduction of the new Radio Amateur Foundation Licence (see under Amateur and Amateur Satellite above), those CB enthusiasts who enjoy radio as a hobby, and have hitherto been daunted by the prospect of studying for the RAE, will be encouraged to consider amateur radio as an attractive alternative.

FUTURE STRATEGY

When the Amateur Foundation Licence has been in existence for sufficient time for its impact to be assessed, it will be a useful opportunity to consider the future strategy for CB Radio (both CEPT and UK channels). This will require consultation with existing licensees and their representative body, the British Citizens Band Confederation (BCBC).

In the meantime, the Agency will be taking forward the implementation of a one-to-one data service on CB using existing CEPT channels. An appraisal of the take-up of this facility will be conducted to establish future requirements.

2.3 SOUND BROADCASTING

CURRENT SPECTRUM USE

Terrestrial analogue sound broadcasting occupies spectrum in the LF, MF, HF and VHF(FM) bands. Spectrum has also been made available for digital radio in the VHF band.

CURRENT ISSUES

2.3.1 SOUND BROADCASTING- ANALOGUE

The demand for spectrum for services in the VHF(FM) band remains strong such that there is increasing difficulty in finding frequencies for new services. Apart from the range of BBC national and local services, the number of commercial

radio licences has doubled since 1990 and there are now around 250 local and national commercial radio stations licensed by the Radio Authority.

In response to these pressures, and supported by the BBC and the Radio Authority, the Agency reviewed last year the scope for additional services in the VHF(FM) Band in the London and Leeds areas. The review concluded that there was scope to introduce a number of services in urban areas with a radius up to 5km with little or no impact on existing services. The Government is therefore considering making spectrum available for a new tier of "community" radio, known as Access Radio. This has a wide definition, including communities based around locality, ethnic or cultural background or other common interests. The Radio Authority is currently seeking to trial a range of services under this banner with a view to advising the Government whether and how Access Radio should go ahead.

However, the review found that it was unlikely that new larger scale services could be introduced in the VHF(FM) band under current planning criteria without impacting to a greater or lesser extent on existing services, notably by way of the need for frequency changes and/or loss of coverage. There is no reason to suggest these findings would differ in other urban areas. However, there could be scope to accommodate larger stations if a more relaxed approach were taken to planning standards (especially as this might have little perceived impact on reception quality in many environments such as kitchens and cars) and the performance of receivers, particularly concerning channel selectivity, were changed to reflect the improvements made over the last 15 years. These issues require further debate and will be taken forward jointly by the Radio Authority, the BBC and the Agency.

The Agency is also examining with the Radio Authority the technical practicability of using HF spectrum for short distance broadcasting within the UK. Current work involves feasibility studies on small area coverages, frequency re-use and suitable antenna types, along with band planning for analogue and future digital schemes. If this work is successful, then the frequencies could be assigned by the Authority for, inter alia, Church/Mosque and other specialist broadcasts which have, hitherto, sought to use CB and Paging frequencies for the purpose.

2.3.2 SOUND BROADCASTING – DIGITAL

Transmissions on the BBC national and commercial national digital multiplexes have begun and the Radio Authority is also licensing sub-national multiplexes at a rate of around one per month. The Radio Authority's current priority is to concentrate on the issuing of licences for the main population centres. The aim is to ensure the establishment of up to two local/regional multiplexes (in addition to the BBC and commercial national multiplexes) in each of the main conurbations (three multiplexes in London).

The cost of receivers is inhibiting the development of digital radio, though prices for both in-home and in-car equipment are falling. Given that households have on average around 7/8 receivers to replace, the lack of any “pay-radio” model, and the limited advantages that digital radio has over analogue for many listening

environments (they are not currently close substitutes) it is premature for the Government to consider analogue radio switch-over.

The industry has requested more spectrum at VHF for digital radio, notably to deal with deficiencies of local multiplex coverage in parts of the country. However, it is unlikely that the Government will be able to accede to this request given the demands of the military (NATO) and the private business community in adjacent bands.

FUTURE STRATEGY

There are 23 blocks of spectrum available in L-Band (1.5 GHz), each of 1.5 MHz bandwidth. 9 of these blocks have been made available for terrestrial use using the Eureka 147 technology and the Government is considering the amount required for digital radio to deal with the spectrum limitations at VHF. However, availability of the band is not assured until 2007 due to its current use for fixed links (see also Fixed Service entry)

The remaining 14 blocks are currently earmarked in CEPT for satellite digital radio. Within the UK, the Government has yet to decide how to licence the blocks and for what purpose(s) though the UK will be participating in a CEPT conference in 2002 to plan a further 7 blocks for terrestrial use to keep open all possible options on use. Once the Government has decided the number of blocks (out of 23 available) that may be required to deliver its broadcasting policy objectives, it is likely that the Agency will consult on the demand for the remaining spectrum from a range of possible uses, satellite and terrestrially based, including datacasting and other "converged" uses.

Productive work is taking place in the ITU on recommended standards for digital radio in the HF band. This is likely to generate considerable interest in re-planning not only the shortwave bands, but also the MF and LF bands for digital use and the Agency will support these activities. Although the digital standard will not lead to more services in the bands, it will improve the quality of services and, thereby, the attractiveness of the spectrum compared with the other sound broadcasting bands.

2.4 TELEVISION BROADCASTING

CURRENT SPECTRUM USE

Analogue TV broadcasting occupies 46 channels, each of 8 MHz, within the band 470-854 MHz. Transmissions of the four main services are taking place from over 1100 sites, providing coverage to 99.4% of the population (Channel 5 uses less than 100 sites giving coverage around the 70% mark).
Digital terrestrial TV (DTT) shares the same 46 channels used by analogue TV.

CURRENT ISSUES

2.4.1 ANALOGUE BROADCASTING

As there is a mature network of analogue services in the UK, there are no major strategic issues. Consideration is now being given to analogue switch-over issues and band re-planning which are considered below.

2.4.2 DIGITAL BROADCASTING

Digital transmissions over terrestrial and satellite platforms began in late 1998 and over cable in 2000-2001. Around one third of UK households now access digital TV over these platforms. Digital Terrestrial transmissions (DTT) on all six multiplexes are now taking place from 80 stations. The Agency's negotiations with neighbouring countries to co-ordinate our respective digital frequency requirements are proceeding smoothly.

The Independent Television Commission (ITC), in consultation with broadcasters, is considering the planning of frequencies to extend DTT coverage and improve the robustness of reception. This work includes considering the use of additional stations and frequencies and increasing the power of transmissions where this can be done without causing interference to analogue reception or to neighbouring countries. The outcome of this work should take core coverage of digital terrestrial TV (the proportion of the population able to receive all six multiplexes) well above 70% of the population.

2.4.3 FUTURE STRATEGY

THE GOVERNMENT'S OBJECTIVES

The Government explained in September 1999 its criteria for the switchover from analogue to digital TV. These are that, before switchover can take place:

- everyone who can currently access the main free-to-air analogue must be able to receive them over one of the digital platforms;
- Switching to digital is an affordable option for the vast majority of people;
- As a target indicator of affordability, 95 % of consumers have access to digital equipment.

When these criteria were first announced in September 1999 the Government said that digital switchover could start to happen as early as 2006 and be completed by 2010.

SPECTRUM PLANNING ISSUES

The DTI and DCMS published in October 2001 a *Draft Digital TV Action Plan*, which brings together a number of stakeholders (including the Government, regulators, broadcasters, manufacturers, retailers and viewers). This will help to deliver an all-digital environment for TV and covers ways in which the Government's criteria for switchover might be met. In December 2001, a

consultation document: *Digital Television: the Principles for Spectrum Planning* on how the spectrum currently used for analogue television broadcasting should be planned once analogue transmissions cease, was issued by DTI and DCMS. Responses to the questions asked in the consultation will inform the way in which detailed plans are developed and agreed by the Government, give guidance to broadcasters for investment purposes and help to inform the UK's objectives in the international discussions on spectrum sharing (see below).

THE INTERNATIONAL DIMENSION

The planning process will also need to take into account a range of uncertainties arising, in particular, from the need for international agreement. A Regional Radio Conference of the ITU, planned for May 2004, will make technical preparations (covering planning methods, sharing criteria etc) for a planning conference in 2005 which will revise the Stockholm 61 agreement on international planning for analogue television. The Conference will cover the bands 174-230 MHz and 470-862 MHz.

The UK hopes that international efforts will achieve a degree of consensus about such key issues as how much UHF spectrum should be released on switch-over, and from which part(s) of the band, and the extent to which the planning principles inherent in the Stockholm Plan may need to change to deal with the growth of cable and satellite broadcasting, convergence developments, and the demand for portable and mobile delivery of broadcasting and other services.

FUTURE USE OF FREQUENCIES

The consultation document*: Digital Television: the Principles for Spectrum Planning* states that, as a result of analogue switchover, it should be possible to develop a frequency plan that releases 12-20 channels nationwide for re-use, along with a number of so-called interleaved spare channels within the DTT plan.

From a spectrum management point of view, these channels would best be released as a contiguous block or blocks so that they can be effectively allocated for a range of technologies. In considering how this freed-up spectrum may be used for broadcasting and other services, and subject to the outcome of international discussions, the Government will take into account the demand from various public and private services along with the way that convergence developments will affect the provision of communications services, particularly in mobile environments.

An all-digital spectrum plan will also allow the spare frequencies interleaved within the plan to be used more effectively. The Government has not yet taken a definitive view about how these interleaved frequencies might be used, though the availability of spectrum for use in theatres and studios (mainly for radiomicrophones) will need to be safeguarded. Various other candidate uses of the band have been proposed, including more standard broadcasting multiplexes (including for use by community TV), mobile broadcasting services, and mobile/fixed data services (including datacasting and Internet access) along with the provision of an in-band interactive channel.

The Agency will also consider, with current radar users, the extent of continued usage of UHF channel 36 and the potential for its use as part of the development of an all digital TV environment.

2.5 BROADCASTING SATELLITE SERVICE

CURRENT ISSUES

WRCs 1997 and 2000 agreed a revised plan for downlinks in the 12 GHz band and related feederlinks at 17 GHz and more flexible planning and co-ordination arrangements. The UK now has guaranteed provision of ten assignments at 33.5 degrees west over a UK footprint. This involved a change in orbital position from 31 degrees west. An advantage of the new location is the possibility of a major expansion of transponder slots available to the UK - up to 40 - and with a wider footprint. In addition, and within the technical parameters of the broadcast assignments, operators have the flexibility to use the resource for a range of non-broadcasting purposes.

FUTURE STRATEGY

The Government is currently considering how this resource might be licensed and plans to publish a consultation document subject to discussions with potential interested parties.

2.6 CORDLESS TELEPHONY

INTRODUCTION

The Agency is in the process of reviewing the future management of all deregulated spectrum, including those bands allocated to cordless telephony (see 2.16 on Short Range and Licence-Exempt Services). One area of particular interest is whether it would be beneficial to allow some form of public use of these bands. Any change in policy resulting from this review may have a significant impact on the use of these bands. The timing of any changes will be subject to public consultation and may vary between bands to take account of existing use.

2.6.1 ANALOGUE CORDLESS

CURRENT SPECTRUM USE

CT0

8 Channels between	1642.00 kHz and 1782.00 kHz (base) 47.45725 MHz and 47.54375 MHz (portable)

CT0 – Additional frequencies

8 Channels between	31.0375 MHz and 31.2125 MHz (base) 39.9375 and 40.1125 MHz (portable)

CT0 – Extended range frequencies

2 channels between	47.43125 MHz and 47.41875 MHz (base)
	77.5125 MHz and 77.5500 MHz (mobile)

CURRENT ISSUES

The UK has three analogue standards for cordless telephony. In common with all areas of radio communications, the trend is away from analogue systems to digital systems. In addition some of the analogue telephony systems have not been as widely utilised as was first envisaged. Following public consultation, the Agency announced in February 2000 that the 8 CT0 channels at 1.6/47.4 MHz and the 2 CT0 – extended range channels at 47.4/ 77.5 MHz will be phased-out in order to re-use the under-utilised spectrum for other new and innovative applications. A phased approach is favoured to the withdrawal of Analogue cordless as it will allow existing manufacturers and users time to migrate to alternative cordless technologies. It is not proposed, at this time, that use by the public of these bands for analogue cordless telephony will be made illegal in the UK; however after April 2005 it will not be permitted to bring new equipment into service and from which sales of such equipment should cease.

There are no current plans to withdraw channels in the 31 and 39 MHz bands, which will remain available for analogue cordless telephony. These channels provide improved resilience to interference, align closely with those used in Spain and the Netherlands for analogue cordless telephones, and overcome the quality problems arising from the use of the 1.7 MHz band.

FUTURE STRATEGY

With developments in the Digital European Cordless Telecommunication (DECT) market and the wide availability of reasonably priced DECT equipment it is not expected that there will be any significant future demand for analogue cordless spectrum.

As already indicated a significant portion of the bands available for analogue cordless telephony are being phased out by 2005. The 8 channels at 31-39 MHz, however, will remain available for the foreseeable future. Exactly how the spectrum released will be re-assigned has not yet been decided.

2.6.2 DIGITAL CORDLESS

MAIN FREQUENCIES OCCUPIED

864.1-868.1 MHz	CT2
880 -1900 MHz	DECT

There are two digital cordless technologies available at the moment: CT2 and DECT (Digital Enhanced Cordless Telephony). The bands are primarily for private use, either domestic or self provided business use. Private use is on the basis of licence exemption. A limited amount of public use for small-scale systems is permitted via the use of a light licensing regime under the WT Act PACT (Public

Access Cordless Telephony) licence in conjunction with the T Act CCL (Cordless Class Licence).

CURRENT ISSUES

DECT is a mature technology and major revisions to the standard are unlikely. A significant number of services can already be offered via DECT equipment both in the home and office environment. Indeed DECT is a technology that has been designated under the IMT-2000 banner.

In contrast, CT2 is a digital cordless telephony system that has never been as successful as anticipated. This is largely due to the success of DECT on a pan-European basis.

As with the CT0 channels mentioned above, CT2 will be phased-out over a 5-year period which started on 1 April 2000. The withdrawal of CT2 telephony reflects recommendations made in the Detailed Spectrum Investigation Phase III report, agreed by the European Radio Committee of the CEPT in March 2001 (see Chapter 1.2.2). The phasing-out of CT2 services is being co-ordinated on a pan-European basis by CEPT. The under-utilised CT2 spectrum will be used for other new and innovative applications, and new services are currently being allocated within this spectrum, for instance two-way paging, asset tracking and SRD use.

As indicated above, the use of deregulated bands for the provision of public services is currently being investigated.

FUTURE STRATEGY

It is expected that future demand for DECT spectrum can be accommodated within the existing allocation. However, change in use, particularly opening up the band for the provision of public services, may place additional strain on the allocation. Any change in policy will need to be carefully considered to ensure congestion in the band does not become a serious problem.

If the review of deregulated bands results in the opening up of the DECT band for public services other than those already catered for under the PACT regime then the management strategy for this band will need to be revisited. Whatever the outcome of the review, this band will remain exclusively for services based on the DECT standard.

2.7 FIXED SERVICE

MAIN FREQUENCIES OCCUPIED

A number of bands from 450 MHz to 58 GHz used for a variety of purposes including point to point links and mobile network infrastructure.

CURRENT ISSUES

The trend over the last few years, for increasing demand for fixed links, continues and is particularly prevalent in the higher frequency bands i.e. 23, 25 and 38 GHz.

During the year 2000 the Agency assigned and licensed over 4,500 new fixed links with around 65% of these links going into the above three bands. This continued demand is mainly due to new operators with new telecommunications services seeking to interconnect their systems and existing operators enhancing established networks.

Work on the Agency fixed link assignment system is also currently being carried out to provide an e-licensing interface which will allow customers to submit licence applications via electronic media with the aim of minimising licence turn around times.

The Agency holds regular bilateral meetings with BT and C&W regarding the spectrum formally exclusively managed by them and will continue progressively to take over management of these bands to enable access by other fixed link operators.

There continue to be numerous sharing issues associated with fixed service spectrum with other services. Taking into account overall UK objectives the Agency will endeavour to protect and promote UK fixed link interests in both national and international fora. Recent discussions in CEPT have produced four new ERC decisions detailing the use of both the FS and the FSS in the following shared bands; 10.7-12.5 GHz, 17.7-19.7 GHz, 27.5-29.5 GHz, and 37.5-39.5 GHz. These decisions set out the regulatory framework for FS/FSS use and avoid band segmentation in the FSS downlink bands. A further decision has also recently been developed and agreed for the 40.5-42.5 GHz band.

The Agency has continued to actively participate in the discussions within CEPT and ITU-R on plans for exploiting new FS frequency bands above 30 GHz e.g. 32 (31.8-33.4 GHz), 52 (51.4-52.6 GHz) and 55GHz (55.78-57 GHz). This work has successfully resulted in new FS frequency allocations, channel plans (in both CEPT and ITU-R) and ETSI standards for fixed link equipment. A phased introduction for the new 32, 52 and 55 GHz bands is planned. The new extended 58 GHz band is already available for un-coordinated fixed link use.

FUTURE STRATEGY

There are several agenda items for WRC-03 that will have an impact on FS spectrum. These include: Identification of HDFSS spectrum (Agenda Item, 1.25), Earth stations on board vessels (Agenda Item, 1.26), Aeronautical MSS at 14 GHz (Agenda Item, 1.11), High Altitude Platforms (Agenda Item, 1.13) and 38/40 GHz technical/regulatory issues (Agenda Item, 1.32). The Agency will continue to participate in the WRC preparatory groups in CEPT and ITU and contribute to the development of the CEPT briefs and proposals for future WRCs.

The introduction of new mobile services (e.g. 3G mobile) and FWA networks is expected to significantly increase fixed link demand over the next few years, primarily in the higher frequency bands. To assess this likely demand the Agency

conducted a survey through a fixed links demand questionnaire aimed at the 3G operators. The results of this survey, which confirmed the expected increase in demand, were presented to the UK Fixed Link Consultative Committee (FLCC).

The progressive introduction of terrestrial and satellite digital radio will require the early migration of affected 1.5 GHz links for which a new band at 1.4 GHz is available. Over the last two years there has been approximately a 25% reduction in the number of links in the old 1.5 GHz sub bands. By 2007 it is intended that all 1.5 GHz links will have vacated the band.

The Agency will continue to actively participate in discussions within CEPT and ITU-R on plans for exploiting new FS frequency bands above 30 GHz.

2.8 FIXED SATELLITE

MAIN FREQUENCIES OCCUPIED

Within the UK frequency bands up to 30 GHz, a total of 7625 MHz of spectrum (6107 MHz shared & 1518 MHz exclusive, with respect to the fixed service) is licensed for civilian FSS operation in the Earth to space direction. For the space to Earth direction a total of 4700 MHz of spectrum (2950 MHz shared & 1750 MHz exclusive with respect to the fixed service) is available for civilian FSS operation.

CURRENT ISSUES

The end of the twentieth century unfortunately witnessed the demise of several new pioneering satellite networks. However, the satellite telecommunications industry in 2001 still continues to grow, and currently remains dominated by operation to satellites placed in the geostationary orbit.

Last year saw the transfer into private ownership of many of the pioneering intergovernmental satellite organisations such as INTELSAT, INMARSAT and EUTELSAT. The UK is the administration responsible for certain INTELSAT filings with the ITU.

The Agency is now beginning to receive the first applications for new Ka- band technologies (Satellite Interactive Terminals) transmitting in the 29.5 to 30 GHz frequency band, and is currently processing these under the existing VSAT network licences. However, the Agency recognises that new licence products are required to encourage the take up of such ubiquitous services within the UK, and is chairing regular working group meetings with satellite network operators and earth station licensees to develop these products. A necessary factor in developing a suitably responsive licensing regime to cater for this new environment is a review of the site clearance procedures. This is being carried out in conjunction with the CAA and MOD.

The Agency has also simplified the process for obtaining authorisations for Transportable Earth Stations (TESs), in line with Government e-commerce

initiatives, through a new online tool called e-FLATCO. This is being jointly funded by the Agency and CAA.

Alongside this process, the Agency has been in consultation with Earth Station Licensees and has developed a new pricing regime for Permanent Earth Stations (PES), with a view to extending similar principles to other new products. The new PES pricing structure is now related to spectrum use and traceable to the fee structure used by Fixed Links, which often share the same spectrum.

The Agency has also held discussions with SNG/TES operators that have resulted in a more flexible approach for TES licensing that facilitates occasional use for special events. The new licence will incorporate the spectrum pricing methodology developed for PES for a transitional period of 1 year while other new licence products are being developed.

'The Ad Hoc Satellite Consultative Committee (SCC) industry consultative group dealing with new products & spectrum pricing has agreed a new network licence product aimed at ubiquitous interactive FSS terminals that operate in the FSS exclusive bands, 14-14.25 and 29.5-30GHz. The new product provides a lighter touch regime consistent with the intent of the ECC licence exemption decisions and is also associated with a new rapid site clearance tool, similar to e-FLATCO. The pricing algorithm is based on the existing PES algorithm with a minimum fee set at 50 terminals and the whole of the UK being treated as one site. The new product has been incorporated into the 2002 spectrum pricing consultation process with the aim of implementation in July 2002.'

With regard to the non-GSO/GSO FSS spectrum sharing issues that have dominated CEPT and ITU-R FSS discussions over the last three years, WRC-2000 adopted ‘hard’ power limits in Articles S21 and S22 of the Radio Regulations. The limits allow coexistence among non-GSO FSS, GSO FSS, GSO BSS, space science and terrestrial systems in several frequency bands in the 10-18 GHz (Ku Band) and 18-30 GHz (Ka Band) range and provide regulatory certainty for both GSO and non-GSO FSS systems.

FUTURE STRATEGY

Several new satellite companies are now choosing the UK as a base for their operations. This will result in a greater emphasis and UK involvement with fixed satellite issues.

The Agency will continue the development of new licence products, referred to above, in consultation with industry.

There are a number of FSS related issues on the agenda for WRC-03, in particular the new topic of identifying suitable spectrum for High Density applications in the fixed satellite service (HDFSS) under Agenda item 1.25.
The Agency will continue to participate in the WRC preparatory groups in CEPT and ITU and contribute to the development of the CEPT briefs and proposals for future WRCs.

2.9 FIXED WIRELESS ACCESS (FWA), INCLUDING BROADBAND FWA

INTRODUCTION

A key Government objective set out in *UK online: the broadband future*, the report by the E-Minister and E-Envoy, is to drive forward a range of broadband networks across the UK, providing faster, cheaper, always-on access to online services. This will increase competition among operators, make possible the delivery of new services for consumers and businesses, such as video conferencing and electronic trading, and reduce transaction costs for businesses.

The Agency's scenario planning exercise, described in Chapter 1, suggests that broadband fixed wireless access services are likely to play an important role over the next 10 years in meeting society's need for high speed, high capacity broadband networks, for work and entertainment, particularly in those areas where it is uneconomic to role out wireline and fibre networks.

Telephony, Internet connectivity and higher data rate services in the 'last mile' or 'local loop' can be provided by Fixed Wireless Access (FWA) systems as an alternative to fibre, cable DSL and phone lines. The services that can be provided include always-on internet and data services and, at higher frequencies, broadband services such as video conferencing.

The target markets for these services include small-medium enterprises (SMEs), single-office, home-offices (SOHOs) for tele-working and sectors of the residential market where always-on, high-speed internet and e-mail are required. Higher bandwidth services may also be particularly attractive to users such as colleges and business parks.

There are a number of frequency bands that can (and do) accommodate FWA operations. The Agency has recently completed a study of the demand for FWA services. Its objectives were to provide an understanding of the competitive positioning of FWA against other access mechanisms and the interrelationships between the frequency bands designated for FWA. Its findings will help inform the Agency's continuing work to optimise the opportunities for operators to provide a range of services. The spectrum in each of the bands has its own characteristics and together the bands offer operators a range of service capacities, from narrowband through higher bandwidth to broadband. Higher bandwidth covers services offering data rates between 384 kbps and 2 Mbps, and broadband covers those offering data rates in excess of 2 Mbps.

FWA BELOW 11GHz

The Agency has published the Interface Requirements for FWA systems (*Multipoint radio-relay systems operating within the 1-11 GHz Fixed Wireless Access bands*, RA 2015), available from the Agency's website (www.radio.gov.uk).

2 GHz (2025-2110 MHz PAIRED WITH 2200-2290 MHz)

Zipcom is currently the only narrowband FWA services licensee in rural areas throughout the UK. Mindful of Government objectives for the availability of broadband services by 2005, the Agency has decided to consult on the obligations and restrictions placed on its FWA licence and published a consultation document on 12 April 2002.

The Agency is also seeking views on the possibility that licences for FWA in the band 2070 - 2108.5 MHz paired with 2245 - 2283.5 MHz should be awarded in respect of the metropolitan areas of Scotland and Wales in order that regional developments in relation to broadband service demand can be addressed.

2.4 GHz (2400 MHz–2483.5 MHz)

Atlantic Telecommunications Ltd (ATL) had offered public FWA services to a customer base of between 12,000 and 13,000 subscribers in Scotland and parts of England. Regrettably, ATL have ceased trading. The Government has revoked the seven licences held by ATL.

The recent consultation on the Use of Licence-Exempt Spectrum for Provision of Public Telecommunication Services did not directly address the issue of ATL's licences, but did suggest that at some point in the future the band might be available for limited commercial use. Depending on the outcome of the consultation, further work may be necessary to define the terms for future public use of spectrum in the band.

3.4 GHz (3425-3442 MHz paired with 3476-3493 MHz)

In the UK these bands are managed by the MoD and their use for FWA is negotiated by the Agency. In December 2000 the Agency published a consultative document on the award of FWA licences at 3.4 GHz and 10 GHz. Since then, the Government has been working for the re-ordering of the spectrum concerned so as to provide the very best offering possible for FWA and the other users of the band. A further consultative document[4] was issued in April 2002 with the prospect of an award of licences for FWA at 3.4 GHz in September. The latest information on the Agency's licensing plans is available on the Agency's website under Public Fixed Wireless Access.

3.6-4.2 GHz (3605-3689 MHz paired with 3925-4009 MHz)

2x36 MHz were made available within these bands for FWA services, subject to co-ordination with fixed satellite users. The allocation is currently used by Tele-2. The Agency has developed a technical co-ordination tool (POMCO) to manage this allocation. The Agency has no plans for further FWA licences in this band at present.

[4] Proposal by the Radiocommunications Agency to Package and Deliver Licences at 3.4 GHz: April 2002

5 GHz BAND

Licence-exempt applications such as R-LANS are intended to operate in a number of frequency ranges between 5150 MHz and 5875 MHz. These ranges are also under consideration for provision of FWA services, using R-LAN technology. The complex issues arising from the possible licensing of a wider range of services in this band are discussed in Chapter 2.16, Short Range Devices and Licence Exempt services and in the Agency's consultation document (*Consultation on the Licence Exempt Use of Spectrum for the Provision of Public Telecommunications Services).*

10 GHz (10.125 GHz-10.225 GHz paired with 10.475-10.575 GHz)

These bands have also been identified for FWA services and again, in the UK, they are mostly managed by MoD. Core bands were assigned in 1996/7 for Fixed Wireless Access services and two national licences were issued. However, these have both now been surrendered. The Agency is currently reviewing the possibility of licensing new FWA services in the 2x60 MHz now available and intends to consult with industry and other interested parties in relation to the award and packaging of licences at 10GHz at a later stage.

2.9.1 BROADBAND FIXED WIRELESS ACCESS AT 27.5-29.5 GHZ

Broadband Fixed Wireless Access (BFWA) is one way of providing end users with links to broadband services. It offers a number advantages over leased lines and fibre, notably flexibility in establishing connections to end users and scalability in developing networks as customers are signed up.

Parts of the 27.5-29.5 GHz band (28.0525-28.4445 GHz paired with 29.0605-29.4525 GHz) have been allocated to BFWA (in accordance with ERC Decision ERC/DEC/(00)09, which addresses the use of the band by the Fixed Service and uncoordinated earth stations of the Fixed Satellite Service). Regional licences were awarded following a spectrum auction in November 2000. Those licences remaining unsold are being made available in a further award process that started in October 2001. Licences will be awarded on a “first come, first served” basis unless there are competing bids for a particular licence in a region, when licences in that region will be awarded by auction.

The Agency will be monitoring the development of broadband services within the band, particularly during the early years of licensees' operations. Licences are for a term of fifteen years. They have a 'Use it or lose it' clause that requires an operator, within eighteen months of its licence being issued, to be in a position to offer services to 10% of business units within its region. The purpose of this clause is to encourage the early provision of broadband services and to allow the recovery of spectrum from operators not meeting this obligation. The obligation holds for the full term of the licence.

2.9.2 MULTIMEDIA WIRELESS SYSTEMS AT 40.5-43.5 GHZ

The 40 GHz band has also been allocated for high capacity broadband services, in particular for converged Multimedia Wireless Systems (MWS). (This is in accordance with ERC Decision ERC/DEC/(99)15). CEPT has also produced a draft ERC Recommendation for the 40 GHz band, which provides guidelines for the accommodation and assignment of MWS. The ERC defines MWS as terrestrial multipoint systems that have their origin in telecommunication and/or broadcasting and provide fixed wireless access direct to the end user for multimedia services. This is an extension of the BFWA concept, embracing interactive multimedia services to domestic, business and public sector customers.

The Agency has been considering how to facilitate and encourage the development of the 40 GHz band for these services. A market analysis, commissioned from KPMG Consulting, suggested that operators were not yet in a position to develop these next generation services on a commercial basis. In the light of this finding the Agency will be exploring with the industry the prospects for developing the band for the delivery of broadband services. It will be examining options for awarding licences that will further the development of these services in the band over the next ten years or so. It will also be considering the scope for the band to develop as a high capacity domestic broadband delivery mechanism to help deliver the Government's broadband objectives set out in *UK online; the broadband future.*

In support of this work, the Agency will be examining how MWS might operate alongside other services in the band. The World Radio Conference (WRC) 2000 agreed to identify on a global basis the 40.5-43.5 GHz band for high density applications in the fixed service (HDFS), but it also extended globally a satellite allocation (space to Earth) at 40.5-42.5 GHz. The Agency is contributing to work following on from this in preparation for WRC-2003. Agenda Item 1.32 (specifically ITU-R Resolution 84 (WRC-2000)) aims to determine the appropriate satellite power flux-density limits to adequately protect the Fixed Service in the bands 40.5-42 GHz from FSS and 42-42.5 GHz from FSS and MSS, and to study technical and operational characteristics and power flux-density values for the BSS in the range 40.5-42.5 GHz.

The Agency is also undertaking studies to establish the necessary operating environment for BFWA around the radio astronomy sites within the UK. This supports ITU-R Resolution 79 (WRC-2000), which urges Administrations to provide contributions to the ITU-R to conduct studies on the co-ordination distance between radio astronomy stations operating in the 42.5-43.5 GHz band and HDFS stations with a view to developing ITU-R Recommendations.

2.10 MOBILE SATELLITE SERVICE

MSS ALLOCATIONS

The following frequency bands are currently allocated to the Mobile-Satellite Service within the United Kingdom:

137-138 MHz
149-150.05* MHz
1525-1559 MHz
1610.5-1626.5 MHz
1626.5-1660.5 MHz
1980-2010 MHz
2170-2200 MHz
2483.5-2500 MHz
14.0–14.25 GHz

*In Northern Ireland 148-150.05MHz

BACKGROUND

The Mobile-Satellite Service (MSS) provides, through a range of regional and global mobile-satellite systems, voice, telemetry and data services for a wide range of applications in the land, maritime and aeronautical services. The MSS industry has been successful in niche markets, in particular the aeronautical and maritime communities where the MSS industry has developed to provide specialist communications for both business and international emergency service applications.

The market trends are towards more data and higher bit rate requirements. This results from the increasing use of PCs, IT and Internet, as in terrestrial communications. There are growing requirements for mobility and hence, an increasing demand for mobile multimedia. It is likely that this demand will result in increased requirements for both terrestrial and satellite communications, as neither terrestrial nor satellite can separately satisfy all market segments.

The United Kingdom is the home of the largest MSS operator, Inmarsat Ltd, and the base for other operators. The UK supports this space industry through a variety of initiatives, such as the DTI British National Space Centre (BNSC) and the European Commission's Advanced Satellite Mobile Systems Task Force Group attended by some 30 European space industries to promote the MSS industry.

CURRENT ISSUES

National

The Agency has initiated a study to determine the compatibility between the mobile-satellite service and the existing terrestrial mobile service operating in the band 148.0125–148.9875 MHz within the UK. Extensive technical studies have

attempted to facilitate Orbcomm Mobile-satellite Earth Stations in the band 148–150.05 MHz (Earth-to-space).

Technical studies have yet to sufficiently demonstrate interference-free co-frequency sharing. Agency policy is to ensure priority is afforded to the terrestrial trunked mobile service used for safety critical activities vital to the UK fuel and power industry. The operation of Mobile-satellite Earth Stations (MES) is therefore limited to the 149–150.05 MHz band within the UK mainland.

International

Mobile-satellite spectrum at L-band (1.5-1.6 GHz) is fully assigned to operational geostationary MSS systems - in all, 10 mobile-satellite operators are assigned spectrum for 22 satellites within a 33 MHz block. The current mechanism utilised to assign spectrum to the mobile-satellite service on a global and regional basis is based on two Memoranda of Understanding between the administrations operating L-band GSO MSS systems. The MoU process, which is based on annual spectrum planning meetings between the L-band operators, has been successful in that the spectrum congestion that was imminent a few years ago has been staved off, and the short-term spectrum requirements of the operators have so far been satisfied. However, there is little scope for networks to expand in the future, or for new networks to get access to L-band MSS spectrum. In contrast, the traffic in MSS systems continues to grow. New systems, some of which are planned for L-band, will therefore have to seek access to other bands, such as S-band (2.9-3.1 GHz).

STRATEGY

Although some uncertainty exists about the size of the as-yet untested 3G market, there is a continuing growth in the demand for existing and evolving MSS. As an example, The Inmarsat business strategy is to pursue a range of new opportunities at the convergence of information technology, telecoms and mobility while continuing to serve traditional maritime, aeronautical, land-mobile and remote-area markets. A keystone of the strategy is the new Inmarsat I-4 satellite system, which from 2004 will support the Inmarsat Broadband Global Area Network (B-GAN). Providing mobile data communications at up to 432kbit/s for Internet access, mobile multimedia and many other advanced applications.

Growth and evolution in existing MSS services, new applications, such as broadcast, Internet, and 3G fill-in applications are planned. On this basis the Agency is supporting additional MSS spectrum requirements and is identifying and pursuing, through CEPT, suitable allocations to satisfy the WRC-03 agenda item 1.31. The target bands at present are 1518–1525 MHz (space-to-Earth) and 1683–1690/1670–1675 MHz (Earth-to-space), which are particularly suitable as MSS expansion bands, being close to the existing L-band allocations.

Other MSS bands (1.6/2.4 GHz, 2 GHz, 2.5/2.6 GHz) are, in contrast to the L-band more lightly utilised. However, some systems are operating and some are planned, e.g. New-ICO. There are also significant constraints in these bands, for example, co-ordination with the fixed service and protection of the radio astronomy service.

In addition, the aeronautical mobile-satellite community is evolving to meet a growing demand for two-way broadband communications by passengers and operators of commercial and business aircraft. The proposed 'Connexion By Boeing' system, for instance, is expected to provide public high-speed Internet/data service to the airborne environment.

The ITU is studying the band 14.0 – 14.5 GHz (Earth-to-space) under the purview of WRC-03 agenda item 1.11, to satisfy the Aeronautical Mobile Satellite Service (AMSS) community spectrum requirements. The agency is actively involved in the ITU process to support the additional allocation to the AMSS whilst ensuring existing services are afforded due protection.

2.11 PRIVATE MOBILE RADIO (PMR)

INTRODUCTION

Private Mobile Radio (PMR) is a generic term used to describe a range of land mobile radio services including paging, wide-area and on-site self provided mobile radio. PMR provides professional users with immediate access to 2-way tailored networks, customised features and specific coverage for voice and data, using appropriate signalling and protocols through owned or shared infrastructures with easily controllable costs even when connected to Public Switched Telephone Networks (PSTN). Wideband data services (>10MBits/s) are also available in the PMR portfolio, operating on a licence-exempt basis, described as Wireless Local Area Networks (WLANs).

CURRENT SPECTRUM USE

PMR operates in a range of frequency bands from 26 MHz to 5.8 GHz; from on-site paging using 26 MHz through to WLANs at microwave frequencies. PMR mainly operates with 12.5/25 kHz channels offering services such as voice and low data rates (<28Kbits/s) described as PMR 2-way radio. WLAN services operate in the 2.4 GHz and 5 GHz bands on a licence exempt basis offering a range of wideband (>10Mbit/s) data services.

FUTURE STRATEGY

In response to the changing and challenging environment for the PMR community the Agency's Private Business Systems Unit is working with the Federation of Communication Services (FCS) to develop a long term strategy for the PMR industry. The first "PMR into the Future" meeting was convened in December 2000 with delegates drawn from the user community, dealers, manufacturers and Agency staff who put forward thoughts and proposals for the future of PMR. These initial proposals included contributions to the PMR strategy detailed below and also towards the setting up of a separate Digital Project Group. The Digital Project Group first met in June 2001 with the aim of establishing the application and scope for digital technology within the Private Business environment and to employ this technology in order to secure future success.

2.11.1 ANALOGUE PMR

BACKGROUND

Analogue PMR is part of the land mobile radio service based on the use of simplex, half and possibly full duplex at the terminal level in order to provide closed user group communications. PMR products follow specific standards such as ETS 300 086, ETS 300 113 and equivalents.

CURRENT ISSUES

The last year has seen a rise in demand for data services on analogue PMR channels, especially in the taxi/vehicle management sector where the transmission of vehicle co-ordinates has led to efficiencies for business use and spectrum management. In addition, many Local Authorities have installed or are preparing to install Private Wide-area trunked systems with data capabilities.

STRATEGY

Although some PMR customers have moved to Public Digital Cellular providers, many are remaining or returning to the use of PMR and Private Wide-Area trunked systems to achieve cost advantages and additional functionality. Therefore the Agency wishes to assist in the introduction of Private Digital PMR services so that the private user can use services at least comparable to those now provided by public digital cellular operators. The Agency foresees that the introduction of new digital services will allow Public/Private roaming onto Public Operated networks/Public Access/Common Base Station/Self provided networks using a Digital PMR handset. The regulatory licensing environments of PAMR and PMR will need to reflect the advances in services and enabling technologies. Aligning the PMR spectrum to CEPT Recommendation T/R 25-08 (Co-ordination of frequencies in the land mobile service in the range 29.7 - 960 MHz) will enable growth of PMR and the introduction of digital functionality.

2.11.2 PMR446

BACKGROUND

This popular analogue voice-only service operates on a harmonised European basis in the band 446-446.1 MHz. It provides low cost, licence-exempt 2-way wireless communications. Equipment is required to meet the provisions of IR 2009.

Equipment is restricted to a maximum ERP of 500mW giving a typical range of a few hundred metres up to 2 km in an ideal environment. There are no restrictions on who may use PMR 446. No frequency assignment is necessary; users simply select one of eight pre-programmed channels and, where fitted, one of the many CTCSS lines/DCS codes.

CURRENT ISSUES

This service has been highly successful, with many high street retailers selling the radios because of the high demand and ease of operation without a licence. In excess of 200,000 mobiles have been sold within the UK.

STRATEGY

The industry vision is to provide a digital radio system operating in deregulated spectrum which is harmonised throughout Europe. The same radio equipment would be re-programmable to extend its capability and functionality such that it could be licensed to provide additional range, trunked operation and even roaming onto other private and public networks.

Within the next 5 years the Agency therefore hopes to introduce a scalable digital system that will offer an equivalent service to PMR 446 but enable a scalable transition to licensed digital services (see entry on Discus below).

2.11.3 SHORT RANGE BUSINESS RADIO

BACKGROUND

Short Range Business Radio (SRBR) was, and, for existing licensees remains, a successful entry-level business radio service. Licences were available until 30th September 1999.

STRATEGY

With the introduction of PMR 446, licensees were notified that SRBR would be phased out. All existing SRBR licences have been extended free of charge until 31st December 2003 at which point the SRBR frequencies will be withdrawn.

2.11.4 SHORT RANGE BUSINESS PAGING

BACKGROUND

SRBR is complemented by a similar paging service known as Short Range Business Paging (SRBP) operating in the 450-470 MHz band. This is an unprotected although licensed service for which no licence fee is payable.

STRATEGY

The UHF2 band re-alignment programme (see below) may shortly require a new channel to be identified for this service. Licensees will be notified and allowed a period of transition, provided through a number of emerging technologies.

2.11.5 DIGITAL PMR

INTRODUCTION

In order to meet business needs the ability to communicate by both voice and data is becoming increasingly important. To achieve this and provide the most competitive environment digital technology must be introduced. Digital PMR

digitises voice as well as providing user data rates usually above those provided by analogue PMR. Additional features such as power control and error correction are typical. Two types of digital PMR have emerged:

- PMR technology that can co-exist efficiently in the same spectrum as analogue FM and without guard bands and using a 12.5KHz channel spacing, such as TETRAPOL and DISCUS. This technology will assist in the re-aligning of UHF spectrum by allowing co-channel and adjacent channel digital technology in existing analogue FM spectrum; and

- PMR technology that does not efficiently co-exist with analogue FM systems and therefore does require guard bands, i.e. TETRA and GSM-R. This technology is more suitable for high capacity networks, which currently have dedicated frequency bands.

The main technologies, which are or have been introduced into the UK, are discussed below:

2.11.6 IR2008

BACKGROUND

Currently, licences using data on a shared analogue PMR channel are required either to meet the requirements of MPT1379 or a channel access scheme that is as efficient. However, MPT 1379 was not designed for shared data services and a technical working group was tasked by the Technical Advisory Group (chaired by the Agency with Industry members) to write a new channel access scheme in 1998. IR2008 will provide a transitional facility to enable analogue data users to move into the digital arena.

CURRENT ISSUES

Earlier this year a specially convened technical working group re-wrote MPT1379 with the aim of allowing more efficient sharing of channels using data on PMR. The result was a new Channel Access Procedure called IR2008, which allows licensees to operate in an exclusive time slot, using TDMA on dedicated channels

STRATEGY

The Agency intends to cease licensing new MPT1379 systems from the end of 2002 and by the end of 2006 intends to withdraw all existing data dominant licences.

2.11.7 DISCUS

BACKGROUND

DISCUS is a standard currently being produced within ETSI, due for completion in 2002. It is anticipated that the standard will enable the introduction of a digital equivalent of PMR 446 (see above) which will be scaleable and extend to a licensed digital PMR 2-way radio and a wide area service. The standard will introduce secure voice and user data rates up to 9600 bps. Although the

standard suggests that DISCUS radio will be able to work between 50-500MHz, it is likely that UHF will be the most desirable frequency range.

STRATEGY

The Agency would wish to licence DISCUS in spectrum re-aligned in accordance with CEPT Recommendation T/R 25-08.

2.11.8 TETRA

(i) PRIVATE TETRA

BACKGROUND

The Agency is under increasing pressure from current and potential private mobile users to provide spectrum for Private TETRA. However, the CEPT harmonised bands for digital radio are either assigned to specific licensees or are some way from being ready for assignment for PMR use, ie:

- The 380-385 MHz/390-395 MHz band has been designated in Europe for emergency services (see entry on PSRCS below). In the UK it is managed by PSSMG (Public Safety Spectrum Management Group).

- Spectrum aligned to T/R 25-08 within the 410-430MHz band was assigned to the public TETRA operator Dolphin, (which went into administration in September 2001).

- Subject to final Ministerial approval it is planned to re-align the 450-470 MHz Band to T/R 25-08. It is expected that the band will then be opened up to PMR digital technologies.

Although the Agency has made available 40 channels in 871-872MHz/916-917MHz for TETRA, there are no PMR licensees in this band. This is mainly due to the lack of available equipment. The use of TETRA in this band was also the subject of a consultation launched by the Agency in August 2001[5]

STRATEGY

The Agency will continue to seek opportunities to provide spectrum for private TETRA networks, particularly in the 450-470MHz band, following the replanning of the band. In the meantime, spectrum remains available in the 871-872/916-917MHz band. The Agency will also be considering the spectrum implications of developments in the 410-430MHz band.

- [5] (*Spectrum for TETRA Mobile Services in the 872-876 MHz and 917-921 MHz Bands*).

(ii) Public Safety Radio Communications Service

BACKGROUND

The Airwave Service (formerly Public Safety Radio Communications Service (PSRCS)) is intended to provide secure national radio communications coverage for the police and a range of other emergency public safety users utilising TETRA technology. The pilot phase, carried out in Lancashire, has now been successfully completed. A national roll out is planned to be completed in England and Wales by the end of 2004. Airwave will operate within the European harmonised public safety frequency band 380-385 / 390-395 MHz. Migration of the current police usage in the 450-470 MHz band will release sufficient spectrum in the 450-470 MHz band (UHF2) to enable re-alignment of the band to the CEPT recommendation T/R 25-08.

An interdepartmental committee, the Public Safety Spectrum Management Group (PSSMG), comprising representatives from the Agency, Scottish Executive, DTI and the Home Office, manages the allocation and assignment of public safety spectrum in the 380-385/390-395 MHz band in the UK ensuring that sufficient spectrum is available to public safety emergency users.

STRATEGY

The Home Office has undertaken to review its frequency allocations following completion of the roll out of PSRCS and it is expected that significant areas of current emergency service spectrum will be released in England and Wales. A commitment to release the bands 450-453 and 464-467 MHz has already been given and this will enable the Agency to commence re-alignment of the 450-470 MHz band.

2.11.9 GSM-R

BACKGROUND

GSM-R (GSM for Railways) is currently on trial in the UK. The spectrum is harmonised to the requirements of CEPT T/R 25-09, 876-880MHz (mobile transmit) & 921-925MHz (base transmit).

The GSM-R roll out program should start in 2002 and be completed by 2006. The GSM-R project is following a European initiative called EIRENE, which is a project of the International Union of Railways (UIC).

STRATEGY

The majority of spectrum that will be vacated when the rail industries move to GSM-R will be in Band III, sub band II (192.5 - 207.5 MHz) and UHF2 (450-470MHz), which is anticipated to be returned to the Agency by 2008. Planning the implementation of GSM-R is now underway.

2.11.10 OTHER PROPRIETARY RADIO TECHNOLOGIES

Other proprietary systems meeting ETS 300 113, such as TETRAPOL, can be licensed providing suitable spectrum can be identified. The Agency is currently considering licensing TETRAPOL systems, where it is feasible to do so using the existing channel raster of the PMR bands. It is hoped that TETRAPOL equipment will be manufactured in VHF spectrum. Other proprietary digital PMR technologies include EDACS, APCO 25, Open Sky, etc.

2.11.11 BAND RE-ALIGNMENT

BACKGROUND

For reasons of spectrum harmonisation within Europe, it is the Agency's intention to align all land mobile frequency bands by 2010 to the structure given in Annex 2 of CEPT Recommendation T/R 25-08, (Co-ordination of frequencies in the land mobile service in the range 29.7 - 960 MHz).

The UK has frequency bands for land mobile that are already aligned to CEPT Recommendation T/R 25-08, these are:

- Band I (55.75-68MHz)
- Band III, SubBand I (176-191MHz)
- Band III, SubBand II (192-207MHz)
- Band III, Sub Band III (209 - 215MHz)

UHF2

Alignment of the 450-470MHz band (UHF2) has become increasingly urgent over the past few years, in order to increase the efficiency of assignments made in the band. Ministerial approval will be sought for the timescale for alignment of the 450-470MHz band. Once agreed, the implementation plan is expected to begin in earnest in 2005. The introduction of new digital technologies will allow efficiency gains and increased user flexibility through migration to new equipment/frequency bands.

UHF1

The Agency will also need to address use of analogue UHF1 in the 425-429 MHz band which is also band reversed.

STRATEGY

UHF2

The alignment of the 450-470 MHz band is a major exercise being carried out by means of a project managed within the Agency in close consultation with users, manufacturers, dealers, other Government Departments. A frequency change plan has been developed in consultation with the industry for effecting the changes required in order to move in a series of steps from the band's current

configuration of allocations to services, to one in which they align with the CEPT Recommendation.

The migration of the majority of Home Office[6] services out of the 450-470 MHz band to the PSRCS by the end of 2004 provides an unprecedented opportunity to improve use of the spectrum by addressing four needs:

- to encourage growth and new technology, including digital, in the land mobile radio bands;
- to provide a logical band assignment structure;
- to address interference from the continent;
- to harmonise allocations in accordance with the European Common Allocation Table.

UHF1

Currently there are no plans to stop the issue of new assignments in this spectrum as closure of this band would remove access to additional UHF assignments during the UHF 2 replanning process. The Agency is starting to open new channels for simplex services in 440-450MHz, in agreement with MoD, in order to ensure the earliest possible compliance with T/R 25-08.

2.12 PROGRAMME-MAKING AND SPECIAL EVENTS

MAIN FREQUENCIES OCCUPIED

The Agency makes available a range of frequencies from 47.55 MHz to 48.5 GHz for use by programme makers, including broadcasters, independent production companies, theatres etc. and for special events, notably the British Grand Prix.

Many of these frequencies are shared with other users, or make use of spectrum that is difficult for other services to use, though the sector also has access to dedicated spectrum. The frequencies are managed on behalf of the Agency by a contractor, currently the Joint Frequency Management Group (JFMG).

CURRENT ISSUES

This sector of radio use underpins an important part of the UK economy.
The demand for spectrum by programme-makers and related users is increasing as a result of a growth in the supply of programme-making opportunities (e.g. due to the growing number of live and recorded events and increasing demand from broadcasting networks for programmes). Also, within individual programmes and

[6] ' **Note:** The Scottish Police and Fire Services are managed by the Scottish Executive - a decision to implement PSRCS in Scotland has been taken by Scottish Police Forces and rollout should be completed by the end of 2005. The position regarding the Scottish Fire Service has yet to be decided with competitive tendering on a non-technology specific basis expected towards the end of 2001.

events, the average use of radio per programme/event is increasing (e.g. more radiomicrophones are required at concerts, more camera angles at events and more mobile cameras, including those placed in novel locations such as in racing cars).

At the same time the supply of spectrum is under pressure from a range of developments including the spectrum needs of digital TV, fixed wireless access and 3G Mobile. For example, the loss of channels for outside broadcasting in the TV band is affecting the availability of spectrum for radio microphones in theatres and studios, while the possible future loss of spectrum in the 2.4 GHz band to 3G Mobile, following the identification of large parts of that band as extension spectrum band for 3G at WRC-2000, will add further pressure to already congested spectrum used by broadcasters and independent production companies for camera, and other video links.
The proposed reconfiguring of the 3.4 GHz band, to facilitate the offer of 2x20 GHz for FWA services (see 2.9 above) will also have important implications for programme makers**.** These are set out in the consultative document issued by the Agency in April 2002 Public Fixed Wireless Access:Proposal by the Radiocommunications Agency to Package and Deliver Licences, . The Agency is discussing with the programme makers affected various remedial options including the use of alternative bands and/or use of digital equipment.

FUTURE STRATEGY

The Agency is seeking to deal with the spectrum pressures in this area of radio use through a range of actions, both national and international (including in fora such as CEPT Project Team 41, which is considering harmonisation of frequencies and conditions of use of wireless audio and video links in programme making applications). Apart from work on international frequency harmonisation, this includes promoting the use of more spectrally efficient techniques, identifying alternative bands and spectrum sharing opportunities, and implementing spectrum pricing. These developments are being taken forward, with the support of JFMG, in the form of a strategic approach to the various pressures on each of the programme making bands, including in the context of combined access to the UHF TV bands after digital switchover.

2.13 PUBLIC NETWORKS

DIGITAL CELLULAR

2.13.1 GSM
MAIN FREQUENCIES OCCUPIED

E-GSM:	880-890 / 925-935 MHz	(2 x 10 MHz)
GSM-900:	890-915 / 935-960 MHz	(2 x 25 MHz
GSM-1800:	1710-1785 / 1805-1880 MHz	(2 x 75 MHz)

CURRENT DEVELOPMENTS

Recent estimates put the number of cellular (GSM) subscribers at around 46 million or approximately 78% of the UK population (based on industry estimates – Mobile Communications March 2002). Growth in this sector remains healthy, with approximately 8 million new subscribers added in the last year. Despite a general downturn in the high-tech sector of the economy during 2001, growth in mobile subscriptions is expected to remain strong, and it is expected that subscriber levels will approach the 90% mark in the medium term (i.e. over the next 3 to 5 years).

TECHNICAL ISSUES

Following on from work in ETSI on enhancements to the 2nd generation of the GSM standard (so called 2.5 generation systems), in 2001 UK operators began offering GPRS (General Packet Radio Service) across their networks. GPRS provides an 'always on' data service at increased bandwidths, and should encourage an increase in mobile Internet access and e-mails, particularly for business users.

REGULATORY ISSUES

The frequency bands 880-890/925-935 MHz were previously allocated to the analogue mobile system ETACS (Extended Total Access Communications System). There has been a rolling program by the incumbent operators to migrate this spectrum to E-GSM use. This process started in October 1999 and was effectively completed in June 2001.

The frequency bands 872-880 / 917-925 MHz were also allocated to the analogue mobile system ETACS. These systems finally ceased operation in June 2001 and the spectrum has been returned to the Agency for reassignment. The band 876-880 / 921-925 MHz has been allocated in Europe to the international railway network; and will be assigned to Railtrack in the UK for GSM-R. The remaining balance of the spectrum, 872-876 / 917-921 MHz has been identified for use by TETRA – a trunked digital PMR system, in accordance with Decision ERC(96)04. The Agency issued a consultation on future plans for this spectrum in August 2001. See separate entry on TETRA for further details.

Both the GSM-900 and GSM-1800 bands were identified at WRC2000 as potential expansion spectrum for 3G/IMT-2000. See section on IMT-2000 below for discussion on this.

FUTURE STRATEGY

Within Europe, operators and manufacturers are concentrating on enabling the roll out of 3G networks, consequently it is unclear whether further enhancements to GSM such as EDGE (Enhanced Data rates for GSM Evolution) will be implemented in the UK. The situation should become clearer in the next few years as the 2G/3G operators develop their plans.

With the impending roll out of 3G networks and the concentration of operators' efforts in this direction it is very unlikely that more spectrum will be made available for GSM use. However, GSM networks will remain a very important part of cellular infrastructure during the early to mid term days of 3G. It is expected that there will be a great deal of roaming from 2G to 3G networks with the bulk of voice calls still being carried by the 2G networks and these networks providing coverage (at least in the initial phase) in the more rural areas where 3G networks will roll out later.

The 900 MHz and 1.8 GHz bands have been identified internationally as expansion bands for 3G. If, when, and how, one or both of these bands is 'refarmed' from 2G to 3G use will depend on the speed of growth in, and nature of, 3G services and the demands this places on the spectrum. However, any refarming from 2G to 3G is expected to be for the longer term. The Government intends to hold a first consultation on these issues once commercial 3G services have been launched towards the end of 2002 or early 2003.

2.13.2 IMT-2000/3G

MAIN FREQUENCIES OCCUPIED

1900-1980 / 2110-2170 MHz	(2 x 60 MHz + 20 MHz)
2010-2025 MHz	(15 MHz licence exempt)

CURRENT DEVELOPMENTS

Following the successful assignment of 3G spectrum by auction in early 2000, operators are now concentrating their efforts on network roll out. The operators have set up trial systems and the results from these trials should assist in establishing operational networks. It is anticipated that commercial services will be launched towards the end of 2002 or early 2003.

TECHNICAL ISSUES

Manufacturers are focusing their efforts on the development of terminals and infrastructure based on release 99 of the IMT-2000 standard for 3G. Development of FDD (frequency division duplex) equipment is progressing steadily and it is expected that there will be sufficient equipment available for operators to launch commercial services towards the end of 2002 or early 2003. Work on TDD (time division duplex) is not progressing as rapidly and it is not expected that operators will be offering TDD access for some time yet.

Release 4 (release 2000 in old parlance) of the 3G standard went ahead in March 2001, the only significant addition in this release was narrow band TDD (i.e. 1/3 of standard 5 MHz channel). Release 5, scheduled for completion during 2002, will add the IP Multimedia Subsystem, high speed down-link packet access (up to 8 Mbs) and beam forming antennas to the standard. However, it is not expected that these enhancements will be implemented for some time after the release.

REGULATORY ISSUES

The existing spectrum allocated at international level for 3G, the so-called core bands, was assigned by auction in early 2000. This was the first use of an auction to assign spectrum licences in the UK and the first 3G auction in the world. Licences were awarded to the 4 existing 2G operators and a new entrant to the UK telecommunications market. The licences are valid until 31 December 2021, allowing for about 20 years of commercial services. The additional competition provided by a new entrant is expected to spur the faster roll out of more innovative services as well as delivering greater choice and lower prices for the consumer.

WRC 2000 identified an additional 190 MHz of spectrum, on a global basis, for IMT-2000. It also earmarked the present 2nd generation mobile bands for IMT 2000, to facilitate evolution/refarming in future. The new IMT-2000 bands are as follows:

806-960 MHz	(includes the GSM-900 allocation)
1710-1885 MHz	(includes the GSM-1800 allocation)
2500-2690 MHz	

The additional bands identified are 2520-2670 MHz for the terrestrial component and 2500-2520 / 2670-2690 MHz for the satellite component although terrestrial services could be implemented in the whole band.

Band plans for the additional spectrum and the evolution from 2G to 3G are currently being studied in ITU-R WP8F and CEPT ECC PT1. Recommendations are unlikely to be available before 2003.

FUTURE STRATEGY

The successful introduction of 3G technology is seen as important to the UK maintaining its leading position in mobile communications technology. The opportunities it offers, including fast multimedia and internet access on the move, are expected to be key factors in facilitating the development of the information society and the growth of e-commerce and m-commerce.

Numerous demand studies (UMTS Forum, Quotient Communication Ltd, etc.) have been completed into the future spectrum requirements of 3G networks. It was on the basis of these studies that further spectrum was identified at WRC 2000.

The spectrum implications of the scenario planning exercise for 3G spectrum were that a total of at least 2 x 240 MHz of symmetric terrestrial spectrum would be required by the year 2010 (based on the Total Mobility scenario). This was very much in line with the predictions of the UMTS Forum. This prediction, however, is based on the assumption that highly asymmetric traffic such as Video on Demand would primarily be carried via other means, such as DTV.

As indicated above, the additional spectrum identified at WRC 2000 will go a long way to meeting this anticipated demand. Given the fact that the current 3G operators are not likely to start offering commercial services until the latter half of

2002 or early 2003 it is not possible to predict, with any degree of certainty, what the actual spectrum requirements, five years hence and more, will be. It is possible that the IMT 2000 allocations could be revisited at WRC 2006 by which time future demand should be easier to predict.

Given that we are in the infancy of 3G services, the Agency believes it is important to establish a degree of regulatory stability in which operators can plan and roll out their networks. Although it is not yet possible to predict future demand with any certainty, it is not expected that additional spectrum for 3G will be required until 2007 at the earliest.

More certainty on future demand and growth will be needed before the Government takes any decisions on the allocation of additional spectrum for 3G. It is likely that the Government will wish to consider the longer term use of the 900 MHz and 1.8 GHz bands, including possible refarming to 3G use, alongside any proposals for further release of spectrum for 3G at 2.5 GHz. The 2.5 GHz band is currently used for Outside Broadcast and Electronic News Gathering and studies are underway on the options for relocation of these services. We expect that, in the near future, notice will be served on the existing users of the 2.5GHz band of the need to relocate to make way for 3G services from about the year 2008. Work progressing in ITU-R WP8F and CEPT ECC PT1 on band planning options will also be important. Key priorities for the Government will be to ensure effective and sustainable competition in the provision of mobile telecommunications services and to make spectrum available in the most efficent manner. The Government intends to hold a public consultation on the technical and licensing policy options once commercial 3G services have been launched towards the end of 2002 or early 2003. Decisions on refarming and the relative priority given to refarming and the assignment of expansion bands will need to take account of, amongst other things: the level of demand and competition; the position of the existing 2G and 3G operators; and the international and European context and requirements of legislation.

Spectrum trading (see Chapter 6) could be of benefit to public mobile operators by permitting spectrum to be transferred between operators or new entrants and thereby stimulating innovation and competition. Trading may well play a role in the strategy for future assignments of additional 3G spectrum and refarming.

2.13.3 COMMON BASE STATION (CBS).

INTRODUCTION

Common Base Stations (CBS) or community repeaters are base stations, which are installed by an operator to provide a mobile communications service on a commercial basis, to a number of independent users. CBS spectrum is assigned on an exclusive basis, thus providing a better quality of service than shared PMR channels. Within a local area, the service may be provided from a transmitter at a single site or up to three sites linked together (typically up to 45 km from the site). Where the number of transmitter sites exceeds three and they are linked together to form a regional or national network, the service is known as Public Access Mobile Radio (PAMR) (see separate entry).

CURRENT SPECTRUM USE

Band 1	54-68 MHz
Low band	68-70.5 MHz
mid band	157-165 MHz
High band	165-174 MHz
band III	174-217 MHz
UHF1	425-448 MHz

CURRENT ISSUES

While CBS still provides a low cost solution to the requirement for radiocommunications, new assignments remain at a low level primarily due to the lack of spectrum in congested areas and competition from the Cellular and PAMR sector.

STRATEGY

New spectrum has been made available in band III sub band 1 to reduce the congestion and demand in other CBS bands which exists predominantly in the large urban conurbations.

The Agency has also reserved channels in this band to provide a migration path and band for those UHF1 CBS that are receiving continental interference or cannot obtain additional channels. The UHF1 band remains closed to new CBS assignments in order to aid the pending realignment of UHF1 to the 410-430 MHz CEPT channel plan and to reduce interference to MoD radio services.

In addition the Agency has decided that, in the absence of any narrow band demand in band III sub III, the channels set aside for new technology will be reconfigured into conventional 12.5 kHz raster channels. In the future these channels will be made available for other use on both public and private assignments, where there is significant demand.

2.13.4 PUBLIC ACCESS MOBILE RADIO (PAMR)

INTRODUCTION

Public Access Mobile Radio (PAMR) systems provide wide area low-density trunked mobile radio communications services, on a commercial basis, to a number of users. PAMR operators offer analogue or digital (mainly voice) communications between mobiles and headquarters. Facilities offered include push to talk communications and group call and Direct Mode operation between mobiles. In the UK, digital PAMR services are provided through TETRA technology. The TETRA market is segmented into three distinct categories - Emergency Services, Private Systems, and Public Network Services (see 2.11.8 on Private TETRA). ETSI is developing an enhanced family of TETRA standards generally referred to as TETRA Release 2. This is expected to provide data rates of up to 130 kilobits per second (kbit/s), compared to current TETRA data rates of 4.8 kbit/s.

MAIN FREQUENCIES OCCUPIED

Analogue:	174-217.2 MHz
Digital:	410-430 MHz

CURRENT ISSUES

Spectrum for analogue PAMR is forecast to be sufficient to cater for future requirements, peaking possibly in 2002 and then falling by 2007 to approximately 50% of the current allocation.

The two original public digital PAMR operators, Tetralink Telecommunications Limited and National Band Three Limited, licensed by the Government in 1996, merged in 1997 to form Dolphin Telecommunications plc (Dolphin). Dolphin is currently in Protective Administration and the Administrator is seeking a buyer for Dolphin's public PAMR businesses.

STRATEGY

At the time of publication the Agency is in close touch with Dolphin's Administrator and is keeping the situation under review. The Agency will, if necessary, carry out appropriate public consultation on the future use of the public TETRA bands in the near future.

2.13.5 PUBLIC MOBILE DATA

Mobile data networks provide two way transmissions of non-voice messages (data). The data is usually transmitted in "packet" form, meaning it is sent in short, high-speed bursts rather than in real time. For example, if sending a text message, the text is typed into a terminal and stored until the user is ready to transmit. This approach makes these networks very spectrum efficient, since a message which might take many seconds to send by voice can be transmitted over the air as data in a small fraction of a second.

SPECTRUM USE

Mid band	157-165 MHz
Band III	174-217 MHz
UHF1	425-448 MHz
UHF2	450-470 MHz
(within CT2 band)	866-868 MHz

STRATEGY

None of the four Public Mobile data networks have requested an increase in their spectrum allocation this year. However, Transcomm have been granted an increase in their maximum ERP from 25 watts to 100 watts following compatibility testing at RTCG. The Agency anticipates that the spectrum demand from all four operators will increase over the next five years.

Quiktrak Ltd provides a new Asset tracking service and is the fifth national Mobile Data operator. Quiktrak were granted a national licence in 2000 and are currently building their network, which should be operational in 2002.

2.13.6 PUBLIC PAGING

MAIN FREQUENCIES OCCUPIED

137-138 MHz
138-141.9 MHz
153-153.5 MHz
169.3938 MHz-169.8188 MHz
169.8188MHz-169.8438 MHz
450-470 MHz

CURRENT ISSUES

In the mid-1990s the paging industry in the UK grew rapidly to about 2 million users mainly due to the uptake in Calling Party Pays (CPP) pagers. Since then the popularity of CPP pagers has waned but the market for subscription pagers has remained resilient with a fairly constant 700,000 users according to the industry

UK paging operators are delivering more text-based services such as email notification and financial information. The industry therefore believes that, although the customer base may be constant, the usage of airtime should continue to grow as more text-based services are offered. This emphasis on text-based services is reflected in recent organisational changes in the paging industry in the UK and Europe in support of wireless messaging, which is a market that is separate from SMS because the message is delivered immediately i.e. “real-time” as opposed to “store and forward”.

There are currently three one-way code technologies in use, these are POCSAG - an open standard which can operate at up to 2400 baud, FLEX - a licensable code that can operate at up to 6400 baud, and ERMES - an open standard developed by ETSI. Because Wide Area Paging Systems are quasi synchronous it is difficult and costly to deploy paging systems that operate at speeds greater than those mentioned above. The UK operates mainly POCSAG and FLEX technology. However, the Agency has reserved spectrum for ERMES in line with ERC Decision (94)02 and Council Directive 90/544/EC and has, since early 2000, taken a technology-neutral approach to the licensing of UK paging services on these frequencies.

Two Way Paging (TWP) using RE-FLEX (a superset of FLEX) is deployed in Eastern Europe, the Americas and parts of Asia (mainly China). In February 2000 the Agency ran an award for TWP licences in the UK through open competition to support the development of paging technology in the face of rapid growth in cellular-based Short Messaging Services (SMS). One TWP licence was awarded in May 2000: however, to-date no services have been deployed.

STRATEGY

The Agency is disappointed that there has been no delivery of services to UK consumers using ERMES or TWP. We therefore propose to review and consult on the future of the spectrum set aside for ERMES and TWP in 2002 and are also seeking to stimulate debate in CEPT on possible alternative uses of the ERMES band (169.4125-169-8125MHz). Developments in the other bands at 138 MHz, 153 MHz and 454 MHz will also be monitored closely by the Agency as the demand for new and innovative mobile radio services continues to grow.

2.14 RADIO NAVIGATION SATELLITE SERVICE (RNSS)

CURRENT FREQUENCY ALLOCATIONS

Prior to WRC-2000
- 1215-1260 MHz
- 1559-1610 MHz

After WRC-2000
- 1164-1300 MHz
- 1300-1350 MHz (Earth to space)
- 1559-1610 MHz
- 5000-5010 MHz (Earth to space)
- 5010-5030 MHz

BACKGROUND

The US Global Positioning System (GPS) and the Russian Global Navigation Satellite System (GLONASS) are currently the only widely available RNSS systems and GPS dominates the global RNSS market. By 2020 the market worth is expected to exceed £50bn, including the value of user services and the related support industry (manufacturing, location-related sales and advertising, traffic congestion reductions, etc). A significant portion of this global market revenue will be generated by services enabled by the European Galileo system. Galileo is being led by the EC and European Space Agency (ESA) and will form part of the world-wide RNSS network including GPS and GLONASS.

GPS

GPS, operated by the US Department of Defense (DoD), provides reliable positioning information to its military, selected Federal agencies, and the military of close allies within NATO; a reduced accuracy service is also available to civilian users. The US DoD deliberately degraded this civilian service up until May 2000 reducing its accuracy to about 100m, but this limitation has since been removed and position accuracies below 10m are now possible. However, during times of crisis, the US reserves the right to selectively deny civilian access to the GPS signal.

Galileo

Galileo was conceived by the EU in the early 1990s and in March 2002 gained the approval and financial backing of major European governments within the European Transport Council. When fully deployed in 2008 it will operate under international civil control and offer location and timing services for commercial, safety, security and governmental applications.

Composed of 27 or more satellites, Galileo will be a global, independent complement to GPS offering similar performance to future GPS, but in addition enhanced Search and Rescue (SAR) and navigation data services are planned. Like GPS, Galileo will provide a free service, but in conjunction with terrestrial components a pay service will allow delivery of integrity and availability guarantees, crucial for "safety-of-life" applications.

The Department of Transport, Local Government and the Regions (DTLR) formulates overall UK policy on Galileo whilst the British National Space Centre (BNSC) co-ordinates with the European Space Agency (ESA) and is responsible for administering the UK subscription to ESA. The Agency is responsible for UK policy on frequency management issues and was instrumental at WRC-2000 in gaining additional harmonised spectrum for new RNSS systems including Galileo.

CURRENT ISSUES

Use of GPS in civilian applications has seen tremendous growth in the last few years and this is set to continue. The increasing reliance of many categories of user including, for example, emergency services as well as many classes of business user, could have significant implications (of which many users are believed to be unaware) should the GPS signal be disrupted for any reason. However, an independent Agency-commissioned study has identified no critical effects due to short-term GPS loss within the next two years. Beyond that, however, some industrial sectors may experience acute difficulties, especially if the loss exceeded a week.

Galileo will not solve the "GPS loss" scenario but may mitigate the situation by offering alternate system availability. In the case of malicious jamming, the wider range of frequencies proposed for use by both Galileo and GPS will help but may not eliminate the problem.

The US has concerns about the secure encrypted service that Galileo plans to offer and discussions with the EU are underway to address this issue. The UK would not support unnecessary restrictions on Galileo but at the same time secure NATO GPS use must not be compromised.

FUTURE STRATEGY

Protection of existing services (particularly the Aeronautical Radionavigation Service) is paramount and new RNSS systems will need to share with existing services without causing harmful interference. The Agency seeks to ensure this by negotiations with other European and international administrations at relevant CEPT and ITU-R meetings.

The UK will continue close co-operation with other EU Member States and the European Commission so that Galileo proceeds on a sound financial basis and brings benefits to the UK and the European community. The UK also supports inter-operability with GPS, which should help stimulate Galileo's success and result in a more robust integrated global RNSS system with a wider range of applications.

2.15 SCIENCE SERVICES

CURRENT SPECTRUM USE

The Science Services comprise the Radioastronomy; Space Research; Earth Exploration-Satellite (EESS); Space Operations, Meteorological Aids, and Standard Frequency and Time Services. The frequency allocations for Science Services include a number of bands within the range 19 kHz to over 100GHz. Some of the principal allocations are shown below:

4995 kHz – 5005 kHz	Standard Frequency and Time Signal
1215 MHz – 1350 MHz	EESS
1400 MHz – 1427 MHz	EESS, Space Research, Radioastronomy (Passive Band)
1660.5 MHz – 1668 MHz	Radioastronomy
2690 - 2 700 MHz	Radioastronomy
5250 MHz – 5460 MHz	EESS
10.68 GHz – 10.7 GHz	Space Research
23.6 - 24 GHz	Radioastronomy, EESS (Passive Band)
31.3 GHz – 31.8 GHz	EESS, Space Research, Radioastronomy
86 GHz – 92 GHz	EESS, Space Research,

CURRENT ISSUES

The two main areas of activity are Radioastronomy and Earth Exploration. The Agency continues to support both radioastronomy and earth exploration in the CEPT project teams, ITU-R Study Group 7 and its associated Working Parties on a number of WRC-03 and other sharing issues.

2.15.1 RADIOASTRONOMY AND SPACE RESEARCH

The Radioastronomy is a passive service and does not involve any radio transmission. The measurements are basically the detection and analysis of very faint electromagnetic emissions from distant cosmic sources. The Radioastronomy service is very susceptible to even very low levels of interference from other radio services and unintentional radiation.

The continued expansion of commercial telecommunications networks is putting increased pressure on spectrum used by passive services. Interference to these passive services can cause particular problems in terms of the loss of data, errors and disruption of scientific research programs.

The Agency continues to support initiatives designed to provide protection to the radioastronomy bands. This includes work within CEPT WGSE PT 21 and ITU-R TG1/7 to develop agreed spurious emission limits. The Agency has recognised the “global” nature of interference from GSO and non-GSO satellite systems and is continuing to consider the implications for future international policy. The ITU-R Task Group 1/7 met in Washington DC during March 2002 to finalise CPM text and Band-by-Band study.

The Agency continues to support sharing studies within some science service bands to ensure the efficient use of the radio spectrum. Studies are continuing on the sharing of the 42.5 GHz to 43.5 GHz band with Point to Multi-Point and Mesh networks.

The issue of compatibility between radio navigation-satellite services (s-E) operating in the frequency band 5010 MHz to 5030 MHz, and the radio astronomy service operating in the band 4990-5000 MHz, is being considered in CEPT WGSE PT28 and ITU-R WP 8D.

OECD GLOBAL SCIENCE FORUM TASK FORCE ON RADIOASTRONOMY

The Organisation of Economic Co-operation and Development (OECD), supported by around 40 countries, is promoting a global approach to scientific collaboration. The OECD Global Science Forum has been set up to look into the barriers that may prevent current and possible future collaboration on major scientific projects. Radioastronomy is one of the specific areas that has been identified for consideration due to the growth in spectrum use generally which is creating an increasingly difficult environment for earth based space research.

The high level of man-made noise can mask the extremely weak electromagnetic radiation from the cosmic source and therefore, in the future, it may be necessary to identify "quiet" locations on the globe for the installation of new radio telescopes. However, interference from the Mobile Satellite Service, particularly Low Earth Orbit Satellites (LEOS) and Medium Earth Orbit Satellites (MEOS) whose orbits cover large parts of the world mean finding potential solutions to this issue is a most challenging task for the group.

The Agency is particularly pleased that Mike Goddard, Director of Spectrum and International Policy, and currently Interim Chief Executive, has been selected to chair the special Task Force, within the OECD Radio astronomy Working Group, which is to investigate spectrum issues. The main aim of the Task Force is to bring together representatives of the radioastronomy community, the satellite industry and regulators to develop and agree a plan for future action. The Task Force held two meetings in 2001 and made good initial progress.

2.15.2 EARTH EXPLORATION SATELLITE SERVICE (EESS)

The Earth Exploration Satellite service provides very useful data on the Earth's changing environment (i.e. polar ice cap, atmosphere, de-forestation and Ozone layer), agriculture monitoring, and weather forecasting.

The Agency is supporting work within CEPT to identify 6 MHz of spectrum in the 420 MHz to 470 MHz frequency band for the Earth Exploration Satellite service, provided that this can be done without adverse effect on existing services. This is in response to a WRC-2003 agenda item that is intended to address an issue first discussed at the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro in 1992. UNCED identified an urgent need for assessment and systematic observation of polar ice, forest cover and rate of forest degradation.

The issue of Ultra Wide Band (UWB) interference to Earth Exploration Satellite (EESS) and Radio Astronomy services is being investigated within the CEPT WGSE PT 24. The Agency is actively involved in this work but intends to supplement it through the commissioning of additional independent studies that will consider the possible aggregate effect of UWB on EESS.

2.16 SHORT RANGE AND LICENCE-EXEMPT SERVICES

INTRODUCTION

Low power short range device (SRD) technologies meet a wide variety of social needs, including radio key entry systems and anti-theft devices; telemetry and data links; wireless microphones; social alarms; baby monitors and medical applications. Most SRDs are exempt from licensing due to their low power and reduced probability of interference to other users (see Chapter 6).

MAIN FREQUENCY BANDS OCCUPIED

The main bands currently allocated to SRDs in the UK, and their principal uses are shown below:

Generic Frequency Band	Short Range Device Application
9 kHz to 30 MHz	Short Range Inductive Applications
27 MHz	Telemetry, Telecommand and Model Control
40 MHz	Telemetry, Telecommand and Model Control
49 MHz	General Purpose Low Power Devices
173 MHz	Alarms, Telemetry, Telecommand and Medical Applications

Generic Frequency Band	Short Range Device Application
405 MHz	Ultra Low Power Medical Implants Devices
418 MHz	General Purpose Telemetry and Telecommand Applications[7]
458 MHz	Alarms, Telemetry, Telecommand and Medical Applications
864 MHz	Cordless Audio Applications
868 MHz	Alarms, Telemetry and Telecommand Applications
2400 MHz	General Purpose Short Range Applications, including CCTV and RFID. Also used for WLANs including Bluetooth Applications.
5.8 GHz	HiperLANs, General Purpose Short Range Applications, including Road Traffic and Transport Telematics
10.5 GHz	Movement Detection
24 GHz	Movement Detection
63 GHz	2nd Phase Road Traffic and Transport Telematics
76 GHz	Vehicle Radar Systems

CURRENT ISSUES

Radio Microphones and Hearing Aids in the band 173.3 to 175.1 MHz

This band has recently been re-planned to provide improved utilisation on a 50kHz or 200kHz raster. Current devices not aligned to the new channel plan may continue in use but all new equipment placed on the market after 31st December 2003 must comply to the new channelling arrangements.

SRD Duty Cycles

A number of manufacturers have expressed concern over the proposed imposition of a 10% duty cycle for SRDs operating in the 433 MHz band. The ECC SRD Maintenance Group (MG) with the aid of CEPT SE PT24 has completed a study to determine the feasibility of allowing increased duty cycles in part or the whole of the band. The Agency has considered the results of this study and, taking into consideration the views of existing users including MoD and Radio Amateurs, will work with industry to develop an acceptable UK policy.

Radio Frequency Identification (RFID)

RFID is an established technology, but the global market and increased use of IT within the supply chain has resulted in renewed emphasis on common frequency bands and standards. The Agency will continue to work with industry, principally through LPRA and the UAN/UCC Consortium to identify the need for technical compatibility studies between RFID and other current and planned uses of SRD bands. Within CEPT, a decision has been made on a strategic plan for 2.45 GHz and this includes the use of the band 2446 to 2454 MHz for high power RFID indoor applications subject to certain technical requirements. The Agency will also continue to participate in the necessary discussions concerning the industry

[7] Note: This band is to be withdrawn by December 2007

proposals for an allocation to meet the requirements of RFID within the general review of the 862 to 870 MHz SRD band.

FUTURE STRATEGY

Withdrawal of certain SRD bands

To allow expansion of licensed services, the following SRD bands will be withdrawn:

Band to be withdrawn	Comment
417.9 to 418.1 MHz	Equipment notified under the R&TTE Directive prior to 31st December 2002 may be taken into service until 31st December 2007. After 31st December 2007, equipment may no longer be taken into service. Existing equipment in service may continue to operate in the band provided interference is not caused to TETRA users.
888 to 889 MHz	All SRDs are to be withdrawn from the band by 31st December 2003 to allow further development of GSM networks. No further SRD equipment can be taken into service.
31.8 to 33.4 GHz	All SRDs are to be withdrawn from this band by 31st December 2003. No further SRD equipment can be taken into service.

Harmonisation of SRD Bands

The value of SRDs to consumers, and the economy as a whole, will be enhanced through adoption of appropriate common European frequency bands and standards. The Agency therefore intends, through continuing close liaison with the Low Power Radio Association (LPRA) and other interested parties, to continue its support, within CEPT, for increased harmonisation of SRD bands in Europe. In particular, the Agency intends, wherever possible, to adopt all relevant ECC Decisions covering SRDs. The Agency will also continue its active participation in technical sharing studies initiated within the ERO SRD Maintenance Group, and the associated CEPT WGSE PT 24. This is intended to increase the number and range of applications possible in licence exempt bands without unduly increasing the probability of mutual interference. Currently, work within these fora that will be actively supported by the Agency includes addressing the issues of limiting duty cycles; future detailed planning of the 863 to 865 MHz band; technical parameters for RFID and regulatory limits for UWB transmissions.

Re-Planning the SRD Band 863 To 865 MHz

Following the third phase of the ERO's Detailed Spectrum Investigation (DSI III), the SRD Maintenance Group has undertaken a review of the 863-865Mhz band, inviting proposals to be submitted by industry. The review includes the 863 to

865 MHz Cordless Audio Devices allocation and the proposed introduction of Frequency Hopping Spread Spectrum (FHSS) or conventional wide and narrow band technologies between 868 and 870 MHz. The Agency would like to encourage improvements in SRD design and will not support the allocation of unnecessarily wide band channels as a substitute for proper frequency stability and receiver selectivity.

2.16.1 ULTRA WIDE BAND TECHNOLOGY (UWB)

BACKGROUND

Advances in signal processing techniques and microelectronics generally have enabled the emergence of UWB devices based on Application Specific Integrated Circuit (ASIC) technology with the potential for integration into mass market consumer products. According to proponents of the technology, UWB has the potential to end spectrum shortage in areas of high use and revolutionise many aspects of military and civil communications. The potential applications of UWB are indeed numerous and include ground probing radar, secure communications, wireless home networking, a range of public safety applications, broadband internet access and short range location, positioning and tracking. The Agency is keen to fully understand these and other potential applications and the possible social benefits. Further, there is a need to study the technical and regulatory implications that might result from any widespread adoption of this technology in mass-market consumer applications.

The principle of UWB is the transmission of exceptionally narrow pulses of energy, with associated sharp rise time, effectively spreading the resulting radiation over an extremely wide bandwidth. This produces a very low average power (typically of the order of -40dBm/Hz) energy burst and has a number of inherent advantages where very short range high data rate secure and robust communications are required, particularly for indoor applications.

Despite the very low average power, the wide bandwidth associated with UWB raises the issue of compatibility with a vast range of potentially co-located conventional narrow band services.

STRATEGY

The Agency is fully aware of the concerns of existing spectrum users about the possible interference potential to current narrow band services from both small numbers of co-located UWB devices and from any general increase in the noise environment that might result from widespread adoption of the technology. It is therefore intended to continue to work closely with other European administrations principally through CEPT Project Team SE24, to determine the technical issues and provide a basis for an agreed policy on regulating UWB.

The Agency also intends to continue the programme of technical evaluation at RTCG, undertaken initially to support CEPT studies, to determine the compatibility of UWB with other services.

2.16.2 USE OF DEREGULATED SPECTRUM FOR PROVISION OF PUBLIC SERVICES

Currently, most low-powered short-range devices are exempted from licensing by Exemption Regulations made under the WT Act. Current Exemption Regulations, however, prohibit the use of this deregulated spectrum for provision of services to third parties by way of business, without a licence. A number of requests have been received from industry, principally within the Agency's Mobile Services Committee (MSC) and including operators, manufacturers and small businesses, for an amendment to the current Regulations to allow licence exempt spectrum to be used to provide commercial services.

There are two principal arguments for considering this. First, there is currently a perceived market demand for very short range broadband extensions to existing public networks, to provide, for example, high speed internet access in public areas such as airport lounges. Second, emerging radio technologies are designed to allow operation of large numbers of compatible devices without causing mutual interference. Such technologies include Wireless Local Area Networks (WLANS) and High Performance WLANS (HIPERLANS) operating in the licence exempt band 5.15 to 5.875 GHz and which were the subject of the Agency's consultation in 1999. The proposal to open up licence exempt spectrum to operators of public services raises a number of technical, economic and regulatory issues.

In October 2001, the Agency therefore published a document *Consultation on the Licence Exempt Use of Spectrum for the Provision of Public Telecommunication Services* setting out proposals to relax, or remove where possible, existing Regulations preventing commercial services in licence exempt spectrum. The consultation attracted over 50 responses and these are currently being considered. Any change in existing Exemption Regulations to allow public access telecommunications will be a matter for Ministers to decide. It is anticipated that a decision will be announced before the summer of 2002.

2.16.3 WIRELESS LANS

INTRODUCTION

A WLAN is a Wireless Local Area Network. It is a high bandwidth, 2-way data communications network using radio as the medium of transmission, rather than optical fibre or copper cable, and operating over a limited geographic area. WLANs provide communication between many types of mobile and nomadic terminals and, in the future, may provide communications for yet more novel services.

These new services have the potential to revolutionise the provision of IT services to business and domestic premises by improving access for a wide range of applications. WLAN technology, whilst restricted to a short range offers very high data rates may be used to offer services complementing existing methods of providing high bandwidth connections for a range of applications. These would include educational networks, video mail, video telephony, interactive museum

guides and distributed database (intranet) services bringing them into the office and home.

CURRENT ISSUES

Recent technological and economic developments have led to a new emphasis on the development of broadband wireless computer networks. As a result, the Agency has experienced growing industry demand to allow the operation of both private and public access systems using WLAN technology in the 2.4 and 5GHz bands under licence-exempt conditions.

WLANs at 2.4 GHz

WLANs use spread spectrum technology in the 2.4 GHz band and are used extensively for the provision of private telecommunications services throughout the UK. The two types of spread spectrum devices used commonly throughout industry at the moment are direct sequence (802.11 b or WiFi up to 11 Mbits/sec) and frequency hopping (802.11, Bluetooth up to 2Mbits). This year has seen a large increase in the use of 802.11b products worldwide due to their integration into PDAs and Laptops.

In the last year there has been a notable increase in the use of private WLANs operating in the 2.4 GHz band to provide infrastructure, one example being access to Schools and colleges requiring broadband services as part of the National Grid For Learning (NGFL) project.

There has also been a dramatic increase in industry demand for services using WLAN equipment in this band, although the expected demand for spectrum with introduction of Bluetooth devices has not yet materialised due to the delay in bringing products to the marketplace. A large proportion of the services proposed have been for the provision of telecommunication services by way of business to a third party, which is not currently permitted under UK rules for the licence exemption in this band. This was the subject of the national Consultation referred to in section 2.16.2 above.

Due to the lack of mitigation techniques for polite access to spectrum in the devices using this band the Agency would expect spectrum congestion to eventually increase particularly in areas of dense use at times of peak demand.

WLANs at 5GHz (Hiperlan)

5GHz WLAN technology will enable coexistence and/or interoperability between different standards and manufacturers' equipment as well being capable of handling data traffic bursting up to 54 Mbits/sec. With the higher data rates and enhanced quality of service mechanisms these new standards can achieve, there is potential to change radically the provision of broadband services in business and domestic premises. WLANs could enhance existing and planned access networks by supporting a range of new services, including educational networks, video mail and video telephony, interactive museum guides, distributed database (intranet) services and streaming of broadcast signals within the home.

In October 1999 the Agency began a process of consultation on the kind of systems and equipment that should be permitted to operate in the 3 main bands available for WLANs at 5GHz, with the publication of a consultation document: *Short Range, High Data Rate Nomadic Equipment operating in the Frequency Range 5150 to 5875 GHz.* The results of that consultation led to the 5GHz Consultation Event organised by Spectrum Management Advisory Group (SMAG) in June 2000. The recommendations of the conference led to the formation of the 5 GHz Advisory Group. The Group delivered its findings and recommendations to RA in February 2001 in the form of a report entitled *Recommendations on the Licensing of the 5GHz (5150-5350, 5470-5725, 5725-5875 MHz) frequency bands- a submission by the UK 5 GHZ Advisory Group*. It concluded that the following services would be likely to be provided:

1 to 5 years

- Migration of some public and private services from 2.4 GHz to 5 GHz band once the approved 5GHz technology becomes available in mid to late 2002;
- Public operators and independent service providers use 5 GHz WLANs to provide broadband lnternet services to the home;
- WLANs used extensively in business premises where companies have a mobile workforce;
- Public operators use WLANs to provide mobile/nomadic services in public hotspots both in competition with and as an enhancement to existing networks (eg 3G, GSM, and Tetra).

5 to 10 years

- The number of different mobile/nomadic applications expands rapidly as chipsets are fitted as standard in electronic consumer products;
- WPAN devices (e.g. Bluetooth) migrate to the 5.8GHz ISM band to enable higher data rate services.

STRATEGY

The consultation on the *Licence Exempt use of Spectrum for the Provision of Public Telecommunications Services* addressed the issue of making frequencies between 5.150 GHz and 5.875 GHz available for public telecommunication services through WLANs that meet the requirements of ERC decision 99-23. In addition, the Agency issued, in December 2001, a consultation document: *Consultation on proposals for Technical Requirements for Short Range, High Data Rate Equipment operating in the frequency range 5150-5875 MHz - Final Stage,* setting out detailed proposals on the technical requirements for regulating the three bands in question.

The future strategy for these bands will be dependent upon decisions taken by Ministers in the light of both the consultations on the use of licence exempt spectrum for public services and the technical proposals for the 5GHz bands. As stated above, an announcement is expected during the summer of 2002.

CHAPTER 3

MILITARY SPECTRUM STRATEGY

3.1 INTRODUCTION

The Ministry of Defence (MoD) UK military spectrum strategy aims to provide and maintain access to the radio spectrum for vital military tasks. In peacetime in the UK these are restricted to training and some operational tasks; however, the MoD is also concerned with spectrum access on a worldwide basis. It recognises the commercial value of spectrum and this forms the basis from which military use of the radio spectrum is effectively and efficiently managed.

The Defence Spectrum Management organisation (DSM) of the MoD is responsible for implementing this strategy and for ensuring that other branches of the MoD, the Defence Procurement Agency and military headquarters staffs are aware of the extent and range of access to radio spectrum necessary for military tasks.

3.1.1 CHANGING MILITARY REQUIREMENTS

The highly mobile nature of military operations and their logistic support requires extensive use of high speed, high capacity communications for voice, data, video conferencing and imagery. Many of these requirements can only be met by the use of radio or satellite links. Similarly, target acquisition and surveillance systems using radar technology and radio navigation play a vital role in many military systems. Military communications, sensor and navigation equipment enhance the capability of fighting systems and multiply the effectiveness of forces. The extensive use of the radio spectrum is therefore a pre-requisite for successful military operations.

The move towards more flexible, highly mobile joint task forces, together with the rapidly expanding demands for more accurate and timely information in both the front line and within headquarters, is causing an exponential growth in the need for bandwidth and thus spectrum. Another factor is that training previously carried out abroad now needs to be done at home. This growth in the military need for spectrum is expected to continue for the foreseeable future and will need careful management if military access to spectrum for both current and future UK defence needs is to be assured.

3.1.2 BALANCING CIVIL AND MILITARY NEEDS

A major challenge facing the MoD and the Agency is to reconcile the increasing demands for both civil and military spectrum. As a means of meeting the wide variety of spectrum needs in the UK, the Agency together with DSM, is seeking to identify means of sharing frequency bands between different users. This

approach recognises that military frequency bands should remain under MoD management but that better spectrum utilisation can be achieved where suitable sharing arrangements can be agreed. Any constraints on such civil and military use of shared spectrum need to be clearly stated and understood. The MoD has been able to make spectrum available on a shared basis for civil services and further bands are under consideration.

As the MoD's needs change, spectrum can be returned to Agency management for civil use, such as is being arranged for the 410 – 430 MHz band, but access to new spectrum will also be required.

3.1.3 THE INTERNATIONAL DIMENSION

Forces must be prepared to deploy anywhere in the world often either to allied countries or in coalition with their forces. A common approach to spectrum management and allocation is needed in order to optimise force capability. There are two main but overlapping allied groups in which DSM participates. They are NATO and the Combined Communications – Electronic Board (CCEB) and they are discussed in the following paragraphs.

The NATO Frequency Management Sub-Committee (FMSC) meets two to three times a year at the NATO headquarters in Brussels. It is unusual among NATO committees in that it combines both military and civil representation. The decisions of the FMSC are subject to endorsement by the NATO C3 Board and Military Committee and represent a military position. The involvement of the civil members is much valued and constrains the proceedings to what would be acceptable to the civil administrations. The civil members undertake to support the military members to the maximum extent possible. The number of nations attending meetings of the FMSC has been expanded not only by the recent accessions of Poland, Hungary and the Czech Republic but also the attendance of Eastern European partners in specific meetings.

The FMSC reports to the NATO C3 Board on all matters concerning frequency management within the alliance and also prepares a NATO military position for each WRC. This serves as guidance to national delegations to the conference and their military delegates who meet several times during the conference.

The FMSC has delegated authority from the NATO nations to manage the frequencies in some bands on a day-to-day basis (e.g. the 225-400 MHz band) and maintains databases of military frequencies and equipment requiring co-ordination across NATO. The FMSC includes a group of communications specialists that meet to consider areas of technical difficulty that arise. The NATO Joint Frequency Agreement (NJFA), produced originally in 1982, lists frequency bands that have been co-ordinated across NATO Europe for military use. These bands have been accepted for military use by civil administrations in NATO and in CEPT.

Each year the heads of the military communications staffs of Australia, Canada, New Zealand, the United Kingdom and the United States, comprising the CCEB, meet to discuss communications matters. Similarly their frequency planners meet six weeks beforehand to prepare a spectrum management report covering the most significant developments in the past year. This liaison on points of concern

continues throughout the year. The main agenda item for these meetings is normally preparation for a forthcoming WRC.

CEPT also arranges a meeting of civil and military representatives under the auspices of the WG-FM once a year. The wider membership of this group allows for more detailed discussion of a wide range of military, navigation and even broadcasting issues. No decisions are taken at these meetings but issues and requirements can be formulated through this group and introduced into CEPT for further consideration.

3.2 MOD SPECTRUM USE AND STRATEGY

VERY LOW FREQUENCY (VLF) BAND (3 - 30 kHz)

Current Use

MoD uses spectrum in the VLF band for maritime sub-surface long-range broadcasts, including communications to strategic naval forces. All requests for co-ordination are passed to MoD for approval.

Civil low power devices also use parts of this band, but these operate on a non-protected basis and are therefore liable to suffer interference from military transmissions. The MoD appreciates that some of these devices have safety-of-life considerations, such as cable-detection, and therefore, as the primary user, it undertakes a duty-of-care. This is achieved by consultation with the manufacturers of such equipment and civil users, through the Agency, to alert them to possible interference.

FUTURE STRATEGY

The VLF band offers unique electromagnetic propagation properties to enable long-range maritime broadcasting. The military will require access to this band for the foreseeable future or until alternative communications systems become available.

MoD will continue to monitor the development of low power uses of the VLF band in the UK and advise the Agency of any concerns.

LOW FREQUENCY (LF) BAND (30 - 300 kHz)

Current Use

Military navigational beacons operate in the LF bands. Military ships and aircraft use the Loran C navigation systems as required. The band is also used for long-range maritime broadcast communications.

FUTURE STRATEGY

The increasing use of Global Positioning Systems may reduce the reliance on surface navigational systems, but until surface navigational systems are declared obsolete, the current military requirements for access to the LF Band for this purpose will continue. The requirement to use LF for long-range maritime and air broadcast communications will also continue and MoD will need to ensure that the assignments to meet both the navigational and communications requirements are protected.

MEDIUM FREQUENCY (MF) BAND (300 - 3000 kHz)

Current Use

Naval and air forces use non-directional MF beacons for navigational purposes. The beacon channels are co-ordinated with other users on a national basis.

The introduction of Asymmetrical Digital Subscriber Lines (ADSL), Very High Speed Digital Subscriber Lines (VDSL) and the transmission of information using Power Line Technology (PLT) cause potential interference to MF and HF users. These technologies when used by the private household or business user can create interference in the frequency band 1.5 – 30 MHz. MoD will monitor the situation and advise military HF users of developments which may effect their HF capability.

FUTURE STRATEGY

MoD will need to retain access to this frequency band until satellite or other systems replace the current systems.

MoD will also support trials and, if necessary, regulations aimed at containing the effects of possible interference of ADSL as the use of the service expands.

HIGH FREQUENCY (HF) BAND (3 - 30 MHz)

Current Use

The HF band is unique in that an element can radiate over long distances through a refraction process in the ionosphere. Frequencies, which enable this process, change throughout a 24-hour period and on a seasonal basis. The military uses the band between 2.5-30 MHz for both long-range strategic and short-range tactical communications. Some Aeronautical Mobile (Off Route) service bands are dedicated for military use, while other HF bands are shared with civil users on a “first come, first served” basis.

HF communications technology has been improved significantly with the introduction of advanced signalling techniques and microprocessor channel control.

Similar concerns over the introduction of ADSL as mentioned in the paragraph on MF are relevant here.

FUTURE STRATEGY

Some HF allocations are subject to review at future World Radiocommunications Conferences (WRC). MoD will represent national military interests during national preparations for the WRC. In addition, MoD will assist NATO to develop its military position for the Conference.

MoD will monitor the global use of HF to identify potential constraints to the use of HF for UK operational deployments

MoD will monitor the introduction of new frequency agile and software driven radios and has also instigated an applied research programme to develop management processes for new technologies to optimise the use of available military HF spectrum.

MoD will also need to support trials and monitor the possible interference effects of ADSL as the use of service expands.

VERY HIGH FREQUENCY (VHF) BAND (30 - 300 MHz)

Current Use

The VHF bands managed by the MoD are heavily used by land based forces to exercise command and control on tactical training exercises. There are insufficient assignments to meet these requirements and this gives rise to a management problem. In addition, this band also supports a fixed communication network, a small number of aircraft assignments for NATO aircraft and many local management radio nets.

FUTURE STRATEGY

MoD intends to move non-tactical local land management radio nets to UHF, as systems are replaced, in order to free VHF channels and to increase the frequency allotment issued to Army Districts for day-to-day assignment.

ULTRA HIGH FREQUENCY (UHF) BAND (300 - 3000 MHz)

Current Use of 225 - 400 MHz

The 225-400 MHz band is the most important part of the spectrum for command and control of NATO operations and has been harmonised for military tactical and mobile communications use throughout NATO countries. The band is managed by NATO and accommodates an important and wide variety of communications systems. These include Air-Ground-Air (A-G-A) assignments, mobile satellite communications, up and down links to the Skynet 4 Stage II and allied military satellites and tactical radio relay use. Pressure for additional spectrum within this band is increasing and this has caused NATO to initiate a review of frequency utilisation within the band.

Tactical radio relay uses a large part of the band to provide the inter-nodal links for its land based radio relay network. All Army radio relay equipment has the

capability to operate in a number of different frequency bands utilising a number of bandwidths; these variables are utilised to meet the tactical requirement. The new tactical radio relay equipment has the ability to provide greater data throughput resulting in a requirement for bandwidths greater than those used currently (from 500kHz to 2 MHz, or possibly even greater). Radio relay training is an important peacetime activity, mainly carried out on training areas away from population centres but some Regular and Territorial Army units also train locally within major centres of population.

NATO has agreed that, subject to national approval, the sub-band 225-230 MHz could be used for civil purposes. Within the UK, the MoD has agreed to the national shared use of this sub-band for Terrestrial Digital Audio Broadcasting. NATO has also agreed to the use of two sub-bands at 380-385 MHz and 390-395 MHz for civil emergency communications. Within the UK, the TETRA system has been specified to meet this requirement and the Home Office has set up a project termed the Public Safety Radio Communications System (PSRCS) (see Chapter 2*)* to meet the needs of police and other safety services in the UK. MoD users will have the opportunity to access this system as required.

FUTURE STRATEGY

The MoD frequency management strategy for this band is to provide frequencies to meet the military tactical communication requirements for ships, land forces, air defence, air traffic control, search and rescue, and mobile satellite links. In addition, MoD will:

- continue to conduct its national management of this band in close co-operation with NATO staff as well as NATO commands and agencies to which UHF frequencies are allotted for day-to-day assignment.

- maintain its support to current tactical radio relay and develop a strategy to support wide-band transmissions.

- closely monitor interference reports from military units that result from T-DAB broadcasts, as the system is extended across Europe and will support NATO to protect the integrity of the military aeronautical distress channel at 243 MHz and confirm the risk to aircraft assignments close to 230 MHz.

- support a NATO reorganisation of air assignments in the 225-400 MHz band to recover channels no longer used and to take advantage of new equipment requiring less bandwidth.

- support potential military users of PSRCS in the 380-385 MHz and 390-395 MHz bands.

- support the assignment of further fixed frequency pairs for Skynet 5 if required.

Current Use of 400 - 450 MHz

The frequency band 400-450 MHz is managed by MoD and is used for meteorological services, land mobile services, and land radars. Part of the band

is shared with Amateur services on a secondary basis. In practice this works well because little frequency co-ordination is required. Any interference problems are quickly resolved by direct contact with the Radio Society of Great Britain.

The frequency band 400.15-406 MHz is used for meteorological sondes and satellites, telemetry and data links.

A long-range early warning surveillance radar (Fylingdales) operates in the band 420-450 MHz. The radar is established under an inter-governmental agreement and is expected to remain for the foreseeable future.

Channels in the band 406-450 MHz are used for base management radios and land mobile nets. Most units operate equipment in this band for security, crash and fire nets, maintenance teams, logistic support etc. Some sub-bands are shared in urban areas with civil private mobile radio systems. Existing military assignments are being phased out of the 410-430 MHz band and reassigned to either the 406-410 or 430-450 MHz bands to allow for the introduction of TETRA for civil users.

FUTURE STRATEGY

MoD will continue the valuable relationship with the Radio Society of Great Britain, although any formal changes in spectrum co-ordination procedures must be arranged through the Agency.

MoD has agreed to withdraw from the band 410-430 MHz and return it to the Agency for civil TETRA use subject to the continued operation of Fylingdales. MoD will continue to work with the Agency to arrange for the progressive release of channels.

MoD will protect meteorological sondes in the 401-406 MHz band.

MoD will seek to accommodate requests for new military UHF assignments and assignments in the bands 406-410 and 430-450 MHz subject to local technical compatibility. In addition, it will provide frequencies for users displaced as a result of releasing 410-430 MHz for civil use.

Current Use of 590 - 598 MHz

MoD shares the UHF frequency band 590-598 MHz with the CAA for aeronautical radio navigation radars.

FUTURE STRATEGY

These equipments will not be replaced in this frequency band when taken out of use.

Current Use of 856 - 860 MHz/870 - 888/915 - 933 MHz

The frequency band 856-860 MHz accommodates a number of 500 kHz tactical training radio relay channels.

The bands 870-888 MHz and 915-933 MHz are managed by MoD and used for Army communications training with wide-band Triffid radio relay sets. There is a military requirement for 10 MHz of harmonised spectrum for tactical radio relay across NATO countries to facilitate cross border operations.

In the past, MoD agreed to share the frequency bands 870-888 and 915-933 MHz with civil analogue cellular systems, subject to some exclusion zones and to an overall pre-emptive return of the spectrum to MoD when necessary. As analogue cellular systems have now been removed, the utilisation of the cleared spectrum is under discussion between MoD and the Agency for occupation by new civil systems including digital cellular systems, TETRA and railway communication systems on a shared basis.

FUTURE STRATEGY

MoD will protect the requirement to support tactical radio relay training for national and NATO forces within the UK and will support NATO's initiative to identify 10 MHz of harmonised spectrum.

MoD will seek suitable sharing arrangements with cellular, TETRA and railway communication systems, to allow for the continuation of military communications training in the frequency bands concerned.

MoD will monitor the development of TETRA technology in this band with a view to satisfying local military management requirements.

Current Use of 960 - 1215 MHz

The frequency band 960-1215 MHz is used globally for aeronautical radionavigation systems. In the UK this band is managed by the CAA, which oversees the introduction and use of civil distance measuring systems (DME) and Traffic Collision Avoidance Systems (TCAS). Military forces use part of the frequency band for a tactical navigation system (TACAN), the assignments for which are co-ordinated through CAA and NATO. The band includes the two channels, 1030 and 1090 MHz, for the current Interrogation Friend or Foe (IFF) and SSR. In addition the important Joint Tactical Information Distribution System (JTIDS) uses frequency hop-sets in the band 969 - 1206 MHz (Note: JTIDS has no frequencies within 20 MHz of the IFF frequencies).

Military forces may operate JTIDS in this band in UK airspace only on a strict non-interference basis to civil aeronautical navigation installations. The CAA-MoD JTIDS agreement contains precise restrictions on JTIDS operation to avoid the possibility of interference to civil DMEs.

FUTURE STRATEGY

The availability of TACAN channels, the use of the Distance Measuring Equipment and the requirement for IFF are essential military requirements and MoD will continue to support these and the JTIDS spectrum requirements, within the agreed frequency constraints.

Current Use of 1215 - 1350 MHz

The frequency band 1215-1350 MHz is used to accommodate long-range surveillance radars primarily for maritime and air defence of the UK. Civil aviation has a similar requirement. The band also includes the assignment of 1227.6 MHz registered with the ITU for military use by the satellites of the Global Positioning System (GPS).

FUTURE STRATEGY

MoD will ensure continued access to this band for long-range radars and maintain protection of the GPS channel.

Current Use 1375 - 1400 MHz and 1427 - 1452 MHz

MoD manages the frequency bands 1375-1400 MHz and 1427-1452 MHz primarily for radio relay equipment tactical training. These bands are also used for wide-band radio equipment used to provide security surveillance, video and data links and essential aeronautical telemetry for military test and development.

FUTURE STRATEGY

MoD will protect radio astronomy in the adjacent frequency band 1400-1427 MHz and ensure that access is retained to the bands for tactical radio relay training and for existing airborne and fixed telemetry links. MoD will phase out the use of this band for airborne telemetry. New installations should be engineered to use the 2310 – 2400 MHz band.

Current Use 1559 - 2450 MHz

The frequency band 1559-1610 MHz is allocated to aeronautical radio navigation services and provides an assignment at 1575.42 MHz for the primary down link of GPS.

Meteorological sondes for the Meteorological Office and Army artillery units operate in the band 1670-1690 MHz; these balloon-mounted devices incorporate low power transmitters, which gradually rise into the troposphere relaying barometric parameters. The frequency band is also designated for use by Terrestrial Flight Telephone System and meteorological satellites transmitting on 1670.5 and 1671.5 MHz; these services require protection from sondes.

There are meteorological satellite systems in the frequency band 1690-1710 MHz; the satellite receiving earth station for these services is at West Freugh.

Satellite Telecommand, Telemetry and Control (TT&C) is provided for the SKYNET satellites at 1760 - 1840 MHz for the command uplinks and 2200 - 2290 MHz for the telemetry downlink. Special arrangements are in place to enable co-ordination with civil services in the uplink band in the vicinity of the TT&C stations in the UK.

Within the frequency bands 2025-2110 MHz and 2220-2290 MHz, 2 x 45 MHz have been identified by CEPT as harmonised frequency bands for tactical radio

relay. These are civil bands in the UK but may be used on prior request for NATO training in specified training areas. Future radio relay equipment should tune over the band 1350 - 2690 to take advantage of these bands that may be adopted as NATO harmonised bands in the future.

The frequency band 2310-2450 MHz is used by military fixed, telemetry and mobile services and is shared with the Home Office. The long-range airborne telemetry links are particularly carefully protected. In Europe a variety of low power devices operate in the bands 2400-2483.5MHz and there is military interest in the use of some of these technologies.

FUTURE STRATEGY

MoD will continue to protect aeronautical radio navigation use of 1559-1610 MHz. Within the 1670-1690 MHz band MoD will ensure that sufficient bandwidth for meteorological sondes is maintained and that the meteorological satellite systems in the frequency band 1690 –1710 MHz are protected.

MoD will support efforts to develop future radio relay equipment with an extended tuning range from 1350-2690 MHz in order to take advantage of the two bands (2025-2110 MHz and 2220-2290 MHz) identified by CEPT for tactical radio relay.

MoD will seek to utilise the sub-band 2400-2483.5 MHz for low power emitters under 100mWatts in order to provide flexibility for future low power devices. New airborne telemetry installations will be restricted to 2310 – 2400 MHz.

Current Use of 2700 - 3600 MHz

Access to the frequency band 2700-3100 MHz for radionavigation is essential to meet the civil/military requirements for ship and aircraft surveillance. The frequency band 2700-2900 MHz houses the airfield surveillance and traffic control radars for civil aviation, and military airfields. Civil maritime, air traffic control and range safety radars operate in the frequency band 2900 - 3100 MHz together with naval radars.

The frequency band 3100-3400 MHz is heavily used for high-powered land, airborne and naval radars with a considerable geographical spread. These include short range air and ship defence systems and long range air defence and airborne radars. Peacetime training includes electronic warfare exercises with countermeasures requiring wide bandwidths, and frequency and band diversity. Sharing with other services is not a practical proposition due to the high powers and specialised modulation techniques of these radars together with the susceptibility to interference of their very sensitive receivers.

In the band 3400-3600 MHz, MoD assigns some frequencies for airborne and naval radars and for radar development. MoD has, however, also agreed to civil use of this band for mobile TV Outside Broadcasts and for civil Fixed Wireless Access.

FUTURE STRATEGY.
Access to the 2700-3100 MHz radionavigation band for naval radars will continue to be required for the foreseeable future.

MoD will also need to maintain access to the 3100 – 3400 MHz band for current and future use of radar equipments. MoD will support the WRC agenda item which promotes the upgrade to primary status of the radiolocation allocation to support naval radars in the 2900 MHz to 3100 MHz band.

SUPER HIGH FREQUENCY (SHF) BAND (3GHZ - 30 GHZ)

Current Use

MoD shares the band 4200-4400 MHz with civil aviation for use by aircraft precision radar altimeters and ground proximity warning systems.

MoD manages the frequency band 4400-5000 MHz for military fixed and mobile services. The band has been harmonised throughout NATO for military services. It is mainly used in the UK for fixed links between military establishments. The band contains many wide-band channels for “down-the-hill” high capacity links for tactical area communications systems. The upper part of the band is shared with radio astronomy and all practical measures are adopted to protect this service from interference.

Aeronautical radio navigation systems occupy the frequency band 5000-5150 MHz. The band is planned for the Microwave Landing System (MLS) and ICAO has made paired assignments for UK military airfields which will be fitted with MLS.

Military tactical radars use the frequency band 5250-5850 MHz for short to medium range functions while sharing with civil outside broadcast links, Meteorological Office weather radars, range tracking, vehicle location, and research and development radars.

The band 7250-7750 MHz covers the UK SKYNET fixed satellite down-links; mobile satellite services use 7250-7300 MHz. The up-link is engineered at 7900-8400 MHz with 7900-7950 MHz for the mobile up-link. This system remains the primary military link to UK forces overseas. The satellite allocation is a harmonised NATO band and several NATO partners have similar satellite systems. The SKYNET up-link band is also used for some military fixed links that have been co-ordinated in order to protect the satellite earth stations from interference. The downlink band 7300-7750 MHz is shared with civil fixed links. MoD co-ordinates these assignments with the Agency. MoD participates in international satellite co-ordination meetings for UK military systems with support from the Agency.

The frequency band 8500-10125 MHz is allocated to the radiolocation service although the frequency band 9300-9500 MHz is primarily for radio navigation. The band is widely used for military radars including battlefield radar, surveillance radars at ranges and MoD DPA sites, precision approach radars at many airfields and on naval vessels for missile control and tracking. Assignments exist also for wide band data links. The need for high discrimination radars is widespread and will continue. Wideband systems are also increasing in number.

MoD manages the band 10.125-10.5 GHz for high discrimination radars, some of which are in development or on trial, and airborne data links. MoD has agreed to limited civil sharing in this band to assist the introduction of Fixed Wireless Access systems; the extent of this sharing is currently under consideration (see chapter 2 Fixed Wireless Access)

The frequency band 13.25-14 GHz is allocated to aeronautical radio navigation and radiolocation. The band is widely used for airborne doppler radars, and naval radars. Assignments have been made to MoD DPA establishments and ranges for the development and use of low-level air defence, surveillance and navigation radars.

A harmonised NATO band has been established in the frequency band 14.62-15.23 GHz for fixed and mobile communications and airborne data links. The band is also used for short-range radio relay and fixed links.

The frequency band 15.7-17.3 GHz is used for a variety of wideband data, command links, trial radars, survey, distance measuring and civil airfield movement control radar devices. The band 15.7-17.1 GHz has been harmonised for military use in NATO.

The harmonised NATO band at 20.2-21.2 GHz is planned for down-link military mobile satellite systems. The mobile satellite allocation is paired with the up-link band of 43.5-45.5 GHz in the NATO Joint Frequency Agreement. Some USAF systems use this band in the UK. There is great pressure for this frequency band to be used for civil satellite systems of non-NATO countries.

A NATO harmonised band exists at 26.5-27.5 GHz for fixed and mobile systems. The band is planned for wide band systems possibly requiring up to 1 GHz of bandwidth. Part of this band and the adjoining band above may be used to implement wide band interactive services. The technology developed for these services could have military applications.

FUTURE STRATEGY

MoD will continue to monitor the use of the SHF band and advise on the use of this band for future equipment programmes. With the requirement for bandwidth increasing, it is foreseen that the military will need to maintain its current spectrum availability.

MoD have identified the 4400-5000 MHz band for the introduction of future tropospheric scatter systems. These systems will be used to establish wide-band, long range communications links over ranges in excess of 300 kilometres.

EXTRA HIGH FREQUENCY (EHF) BAND (30 GHZ AND ABOVE)

Current Use

There is no current use but the frequency band 30-31 GHz is a NATO harmonised band planned for mobile military satellite systems; it is also paired with the frequency band 20.2-21.2 GHz for military use.

Naval, land and airborne tracking radars operate in the frequency band 33.4-36.0 GHz. The band is harmonised in NATO for radiolocation.

The frequency band 36-37 GHz is a NATO harmonised band planned for military fixed and mobile services: there is no current use.

The frequency band 39.5-40.5 GHz is a NATO harmonised band planned for satellite systems. It is paired with the frequency band 50.4-51.4 GHz: there is no current use.

The frequency band 50.4-51.4 GHz is a NATO harmonised band planned for future satellite systems paired with the frequency band 39.5-40.5 GHz: there is no current use

Although there is no current use, the frequency band 59-61 GHz is a NATO harmonised band being developed for radar, fixed and mobile systems. In the UK the frequency band 59-64 GHz is allocated to fixed, mobile and radiolocation services. MoD manages the mobile and radiolocation usage. Radar systems are also under development. With the high radio propagation losses in these frequency bands it is expected that sharing between different services will not be difficult.

The following bands, although not exclusively military, are identified for future systems:

71-74 GHz: Fixed, Fixed satellite, Mobile, and Mobile satellite services.

77-81 GHz: Radiolocation services. Trials are current.

81-84 GHz: Fixed, Fixed satellite, Mobile, and Mobile satellite services.

92-95 GHz: Fixed, Fixed satellite, Mobile and Radiolocation services. Trials are current.

95-100 GHz: Mobile, Mobile satellite, Radio navigation satellite, short range radiolocation devices.

FUTURE STRATEGY

MoD will monitor the use of the EHF band and identify developing military trends, which may use this spectrum. As with all evolving military technology, new equipments are spectrum hungry and require increasing bandwidths. MoD will advise equipment capability managers on the availability of spectrum to meet their requirements.

MoD will maintain spectrum allocations to all military systems currently occupying spectrum within the EHF band.

MoD will maintain its support to NATO to retain those bands which have been harmonised while supporting NATO in harmonising further sub-bands.

CHAPTER 4

AERONAUTICAL SPECTRUM STRATEGY

INTRODUCTION

The Organisation of Aeronautical Spectrum Management

1. Spectrum for aeronautical use, as for all other spectrum uses, is allocated by the International Telecommunication Union (ITU). However, in order to achieve global interoperability, equipment standards and frequency planning criteria are harmonised through the International Civil Aviation Organisation (ICAO), which requires compliance with published Standards and Recommended Practices (SARPs). In addition, within Europe the European Organisation for the Safety of Air Navigation, Eurocontrol, provides the institutional and support framework within which the spectrum and frequency management processes are co-ordinated in conjunction with ICAO.

2. The overall aim is to ensure that the Communications, Navigation and Surveillance (CNS) Strategies in support of aviation in Europe can be achieved. However, the overall responsibility for spectrum and frequency management remains a matter for national Governments. Nevertheless, there is further political oversight of activities on a regional basis by the European Civil Aviation Conference (ECAC) which is attended by Ministers of Transport. This body, which meets every two years, maintains a keen interest in ensuring that Eurocontrol, ICAO (on a regional basis) and the Member States deliver the necessary services, including spectrum and frequency management.

3. Within the UK, the Directorate of Airspace Policy (DAP) of the Civil Aviation Authority (CAA), the specialist aviation regulator, is responsible to the Department of Transport, Local Government and the Regions (DTLR) for spectrum and frequency management. DAP's Surveillance and Spectrum Management Section works closely with the Agency to address aviation spectrum issues. In addition, DAP is responsible for frequency assignment within the aeronautical bands.

4. Close liaison is maintained with all user groups through a formal consultation process and regular informal contacts. This is particularly important with organisations such as MoD and National Air Traffic Services Ltd (NATS). NATS, (which was part of CAA until April 2001) provides air traffic control and air traffic management services on a commercial basis and therefore has a major interest in spectrum and frequency management issues.

Current Spectrum Use

5. Aviation is a relatively high volume spectrum user as a result of the need to support the CNS requirements. These are essential to ensuring the safe and

expeditious flow of air traffic. Aeronautical use accounts for some 26% of allocated bands between 960 and 3000 MHz, and 10% of bands between 3 and 10 GHz.

6. Aviation use covers a broad range of CNS requirements. Air-Ground voice communications are primarily met by VHF, which is in high demand and therefore under acute pressure. However, the introduction of 8.33 kHz channel spacing, as described in para 21, and in time the increased use of datalinks (para 17), will enable increasing demand to be managed more effectively. In addition, UHF and HF continue to be used to support certain voice communication applications. Navigational requirements are based on Distance Measuring Equipment (DME), Instrument Landing Systems (ILS), VHF Omni-Directional Range (VOR) and Non-Directional Beacon (NDB). Although within Europe there are plans to reduce reliance on these traditional systems to support commercial aviation en-route navigation, they will be required for many years by general aviation and for airport approach procedures. In respect of Microwave Landing Systems (MLS), plans are being developed for implementation at 11 civil airports and 29 military airfields from 2002 onwards.

7. Significant work on developing Global Navigation Satellite System (GNSS) applications continues but frequency protection issues will need to be resolved as a key element of any approvals process (para 23). Surveillance requirements continue to be met through extensive use of primary radar, which does not rely on co-operative aircraft systems thereby providing reliable independent surveillance. This is increasingly complemented by the use of Secondary Surveillance Radar (SSR), which does require the carriage and operation of Transponders. However, in addition to meeting Air Traffic Service provision needs, SSR also forms the basis for Airborne Collision Avoidance Systems (ACAS).

CAA's APPROACH TO SPECTRUM MANAGEMENT

BACKGROUND

8. Although there are certain similarities with other spectrum users, aviation occupies a relatively unique position. Availability of spectrum is essential to support all CNS aspects of aviation. Furthermore, there is a fundamental underlying principle of safety criticality that demands appropriate protection levels for these services. Failure to sustain the necessary protection, for example if the integrity of data or equipment performance could no longer be guaranteed to the extent necessary to support an operational requirement due to changes to spectrum protection or sharing arrangements, could result in the need to adopt revised practices such as reduced capacity measures, or the introduction of additional technical requirements, in order to achieve the necessary safety standards. This could incur a significant economic cost to the industry, with considerable consequential effects on the national economy.

9. To illustrate the importance to the UK economy, it should be noted that the aviation industry:

- contributes £10.2 billion a year to UK GDP;
- generates 180,000 direct UK jobs;
- exports £6.6 billion a year of services;
- invests £2.5 billion a year in the UK;
- contributes £2.5 billion a year to the Exchequer;
- generates and supports 380,000 indirect UK jobs;
- transports £35 billion of UK exports.

(Source: The Contribution of the Aviation Industry to the UK Economy; Published by Oxford Economic Forecasting Nov 99)

10. The management of aeronautical spectrum is further complicated by its regional and global nature. Consequently, international co-ordination in both use and standards is required to achieve the interoperability necessary to ensure the safe and efficient transit of aircraft. Therefore, global consultation and significant periods of notice (normally seven years, but exceptionally five) are necessary to effect change. In addition, users of aeronautical spectrum cover a diverse range of groups including commercial users, military, sport and recreational. Not surprisingly, these users have disparate, and often conflicting, operational requirements.

11. Increased requirements for spectrum originating from commercial aviation and, in particular, non-aviation commercial interests to share or acquire aeronautical spectrum, have focused attention on the importance of spectrum. As a result, there has been a significant reappraisal of how aviation conducts spectrum and frequency management, not only within the UK, but also from a European and global perspective. This work is being co-ordinated by Eurocontrol with participation from ICAO and national administrations, whilst in the UK, DAP is reviewing the national and internal procedures to identify more efficient practices.

CURRENT INTERNATIONAL INITIATIVES

12. In January 2000, ECAC Transport Ministers addressed radio frequency spectrum issues as a result of general concerns over frequency management. A specific action was placed on Eurocontrol, in conjunction with the Member States and ICAO, to develop a stronger co-ordination mechanism for the management, assignment and auditing of aviation spectrum within the airspace of the ECAC Countries.

13. As a result of this, proposals aimed at improving efficiencies and ensuring that aviation has credible working practices are now at an advanced stage. The CAA has been an active participant in this activity and intends to ensure that aeronautical spectrum and frequency management in the UK meets the requirements of best practice, transparency and efficiency in order to deliver the most effective use of airspace and spectrum.

CURRENT UK INITIATIVES

Regulatory Issues

Compliance Monitoring

14. The CAA, following the establishment of revised powers within the Transport 2000 Act, recognises that it is essential to monitor activity within the aeronautical bands to ensure that CAA policy and assignments are being complied with. Work is in progress to develop the most effective means of achieving this. This is likely to include a combination of closer scrutiny of usage, correlation between Wireless Telegraphy Act (WT Act) licensing and assignment processes, monitoring of the implementation of spectrally efficient equipment and real time monitoring. Furthermore, this activity will enable the CAA to ensure that the UK complies with the changes introduced as a result of the activities detailed in para 13.

WT Act Licensing

15. Following extensive consultation, arrangements have been finalised for the delegation of aeronautical radio licensing to the Civil Aviation Authority (CAA). The contract was agreed and signed in December of 2001 and the CAA's Radio Licensing Section became fully operational on 14 January 2002. Whilst the Agency will retain overall responsibility for aeronautical licensing policy, the delegation of the day to day licensing function by CAA will enable 'joined-up' regulation and increase the speed and accuracy of licences issued in the Sector. Initial indications are that this move has proved to be very popular with the user community.

Independent Spectrum Review and Administrative Pricing

16. .The independent Review has acknowledged the linkage of the aeronautical spectrum to safety-of-life issues and international obligations which means that it cannot automatically be subjected to economic drivers in the interests of efficiency. However, as it states, there is no doubt that administrative/incentive pricing could be used to encourage greater efficiency in spectrum usage. In particular, there needs to be a process which discourages users from continuing to operate with equipment or systems that are not spectrally efficient.

Technical/Operational Issues

Datalinks

17. The potential benefits of datalinks to aviation have long been recognised and the work is now being co-ordinated in a European programme known as LINK 2000+. Although datalinks will not reduce the requirement for aeronautical spectrum, they could facilitate greater spectral efficiency. In short, datalinks will enable the increased demands emanating from the growth in commercial air transport to be met by more efficient communications and data exchange systems, particularly in ground-air communications. It is envisaged that implementation will occur from 2003.

UNICOM

18. A system known as UNICOM is in use in many countries which allows small airfields with relatively few movements and operating in uncongested airspace, to utilise a common frequency rather than using discrete allocations which place a heavy demand on available frequencies. For several years, CAA has been considering the feasibility of such an approach in the UK. Work is underway to determine how such a system could be implemented in the UK. However, it is recognised that it is unlikely that a single frequency could safely meet the requirement due to the high-density use of UK airspace and the need to manage the potential interference between airfields in close proximity. In addition, the title would be changed in order to differentiate between UK and other countries implementation.

Broadband Telecommunications

19. The CAA is fully engaged with the Agency in determining the impact of broadband telecommunication technologies, e.g. ADSL and PLT, on radionavigation aids and other aeronautical services. The particular concern is that the cumulative impact of such systems, may degrade aeronautical services.

FUTURE STRATEGY

20. Against the background described above, the priority for the CAA's strategic approach to spectrum management is to ensure that adequate protection to existing use is maintained and that there is sufficient access to meet international obligations and safety of life requirements. However, these concerns have to be balanced against a continuing need to ensure that maximum efficiency in the use of aeronautical spectrum is achieved. These considerations will guide the CAA's approach to the issues listed below.

8.33 kHz Channel Spacing

21. Although 8 European countries introduced 8.33 kHz channel spacing in October 1999, the UK was not in a position to participate at that time. However, it was declared that the UK intended to introduce 8.33 kHz channel spacing in 2002. It has now been agreed that within Europe, 8.33 kHz channel spacing will be implemented on 31 Oct 2002 across a wide range of Countries, including the UK, for airspace above FL245. Although this will eventually ensure that upper airspace efficiency measures can be implemented without being restricted by lack of frequencies, full benefits can only be realised if 8.33 kHz channel spacing is also used at lower levels within the airspace structure. Despite few European Countries or users groups being supportive, a study group has been established by Eurocontrol to investigate the feasibility of vertical expansion of 8.33 kHz channel spacing into airspace below FL245. The UK is participating fully in this work.

Primary Radar

22. Following continuing pressure on the 2.7-2.9 GHz band which is used for primary radar, the Agency is conducting a review, in consultation with the CAA

and MCA, to identify the operational and protection requirements against which spectral efficiency improvements can be achieved through economic incentives. Primary radar is critical to ATC operations in that it provides the means by which position, course and speed information is derived independent of aircraft systems. However, the CAA supports this ongoing work as, at the very least, it will provide a definitive summary of the issues involved, and more importantly, provide a focus to establish a way forward.

GNSS

23. The prime concern for aviation in spectrum terms is that if the use of Global Positioning System (GPS) is to be authorised for sole source navigation information, the issue of frequency protection is key in resolving certification, accuracy, integrity and continuity. The CAA will need to work closely with the Agency to address this issue. An additional aspect is the planned introduction of Ground Based Augmentation System (GBAS), which provides differential correction information allowing GNSS to be used for approach purposes. This uses a communications link to provide an enhancement to a radionavigation service. Consequently, it will be subject to a proposal under the World Radiocommunications Conference (WRC-03) agenda item 1.28, to regularise the situation. Finally, the introduction of the new GPS frequency L5 has the potential to require approximately 200 European DME frequency reassignments.

CHAPTER 5

MARITIME SPECTRUM STRATEGY

INTRODUCTION

Those who go down to the sea in ships (or, for example, go windsurfing) make use of maritime radios for general communications and to send distress messages. The Maritime and Coastguard Agency[8] (MCA) is a significant user of spectrum (for HM Coastguard operational communications) and is the national administration with responsibility for maritime radiocommunications (specifically the Global Maritime Distress and Safety System (GMDSS)) and radiodetermination (specifically radionavigation). Thus MCA works in partnership with the Agency, to address spectrum issues for the maritime sector.

2. The beginnings of maritime radio are associated in the public mind with two events – the shipboard detention of Dr Crippen as he attempted to escape with his secretary, Ethel le Neve, and the loss of the *Titanic*.

3. From that event in 1912 until the implementation of GMDSS (1992-1999) little changed in the way radio was used to save lives at sea. Technology advanced during that time (the development of radar and satellite technology are but two examples) but the principle that ships in distress used radio to contact other nearby vessels for assistance remained the same. The arrival of GMDSS shifted once and for all the co-ordination of maritime search and rescue to shore-based installations (coast radio stations and coastguard stations). The activities of the MCA and its predecessors have adapted to take account of this change.

4. Over time a number of frequencies have been allocated both nationally and internationally for distress and safety, search and rescue and emergencies at sea, as well as on land, in the air and in space.

5. Professional seafarers and users of leisure craft are making increased use of radio spectrum. The bridge of a modern ship is crammed with a host of radio-based communication devices and the vessel's superstructure bristles with antennae. These devices serve a number of purposes – general ship-to-ship, shore-to–ship and ship-to-shore communications, distress calling and receiving navigational and meteorological information are just some of them - delivered via satellite or land-based stations. There is an increasing demand for access to modern facilities such as the Internet and other broadband services. Most ships use radar as a navigational aid. Short-range devices are increasingly being employed for on-board communications, port operations and crew locating. HM Coastguard require spectrum operationally as they carry out search and rescue and counter-pollution operations and cliff rescues. HMCG also broadcasts weather bulletins. Even jet skiers, windsurfers and kayak users are increasingly carrying handheld radios and small rescue beacons.

[8] The Maritime and Coastguard Agency is an executive agency of the Department of Transport, Local Government and the Regions

RADAR

6. The largest use, in terms of maritime spectrum however, is radar. With its idiosyncratic operational characteristics, radar presents challenges mostly quite different to those presented by other radiocommunications technologies. The International Maritime Organisation (IMO) has adopted various resolutions that contain performance standards for radar equipment. These cover conventional shipborne radar, high-speed craft and for vessels operating in polar waters. The carriage of such radar equipment is a mandatory requirement contained within the IMO Conventions.

7. In addition there are many other non-mandatory maritime radars, both fixed and mobile, that have similar requirements to those mandated by the IMO.

8. To meet the operational requirements the global radar industry has examined, since World War II, most of the possible radiodetermination frequency bands in the radio spectrum. This examination has shown that bands between 12 and 40 GHz are not suitable due to absorption and attenuation problems that severely limit range performance. The 5 GHz band has been used but is not popular with users, as it does not provide a distinct difference in performance from other possible bands. The best possible compromise has been the bands at 2900–3100 MHz (S-Band) and 9200–9500 MHz (X-Band) The lower bands e.g. 1215–1300 MHz have been ruled out on the grounds of the size and weight of the antennae which would be three times larger than at 2900–3100 MHz, and the reduced surface propagation performance.

9. Operational requirements determine the choice of frequency bands and the use of the radio spectrum within those bands. Characteristics such as range discrimination and minimum range determine the necessary bandwidth of the radar transmission. Current radars operate throughout the S and X bands and are not separated into individual channels.

10. The radar population at S-Band is estimated at 30,000 at sea, and some few hundreds in shore based applications. The population at X-Band is estimated to be over 100,000 at sea meeting the IMO requirement, in excess of 1,000,000 in leisure craft, and some few thousand in shore-based applications and use in inland waterways.

11. The use of the S and X Bands is complementary. The characteristics required cover performance in precipitation and sea clutter, azimuth resolution, and low elevation angles. Other considerations include physical size of antennae, anti-collision, navigation, maximum range etc.

12. Additional performance requirements include the ability to detect search and rescue transponders (SARTs) and radar beacons (RACONS) and to detect different targets on the same bearing (range resolution/discrimination) and a target at minimum range.

13. Over the years these radars, particularly in the S-Band have suffered severe interference from other services. As technology advanced anti-interference techniques have been devised and such radars have been able to co-exist with other radiodetermination radar systems. There is a limit to how far

these techniques can be effective without causing an unacceptable reduction in radar performance.

CURRENT ISSUES

Review of Radar Use

14. In recognition of the significant amount of spectrum used by civil aeronautical and maritime radar systems, a study is underway to investigate the characteristics, operation and protection requirements of these systems operating up to 16 GHz. This will allow investigation into possible rationalisation of existing radar frequency allocations and enable sharing studies to be conducted. The study is being carried out by the Agency, in consultation with the MCA and CAA. It will cover, but is not limited to the following:

a) an audit of the present use of radar;

b) an investigation into the wanted transmission characteristics and operational parameters of existing and state-of-the-art civil radar systems;

c) an investigation into the measured unwanted emission levels from 30 MHz to 30 GHz. Systems to be studied include existing and state-of-the-art civil radar systems operating in all civil frequency bands;

d) a study of mitigation options which could be taken into consideration in the design and implementation of radar systems to reduce unwanted emissions and/or occupied bandwidth; and

e) an investigation into the radar receiver characteristics and protection criteria required for the protection of radar services.

Commercial pressures on maritime spectrum

15. The IMO is aware of the international studies that are in progress with regard to the future use of various bands that include 2700 – 3400 MHz. The IMO intends to review its current radar performance standards and examine the possibility of achieving a more efficient use of the radio spectrum. During this study IMO is expected to reaffirm that radar will continue to be an essential item of navigational equipment for hazard detection and warning. The time scale for this study is likely to extend to 2003.

16. Confirmation or even enhancement of the current range discrimination requirement would lead to the need to examine a requirement for increased spectrum availability in the band 3100–3300 MHz for maritime radionavigation radar systems.

17. The Conference of European Postal and Telecommunications administrations (CEPT) is currently carrying out two studies that impact on the use of maritime radionavigation radar systems.

18. In CEPT Project Team SE34, the study includes the possibility of sharing between radionavigation/radiolocation services and other services in the band 2700–2900 MHz, and sharing between the radiodetermination service and other services in other bands between 2900–3400 MHz. This clearly impacts on the future use of the band 2900–3100 MHz by maritime radionavigation radar systems.

19. In CEPT FM31 there is a continuing study on the future use of the band 2700–3400 MHz. This includes the future maritime radar requirements. The study awaits the outcome of the current work in SE34.

20. In CEPT RR2 and SE31, studies are underway to review the use of the maritime HF bands, particularly with a view to the introduction of digital technology for e-mail communications. The UK, while supportive of such technology, are intending to issue a consultation document with regard to the requirements and future (maritime) use of segments of the MF / HF / VHF bands in the light of declining public correspondence use.

Unwanted Emissions

21. The International Telecommunication Union (ITU) has recently developed new recommendations concerned with unwanted emissions, and intends to amend the Radio Regulations in 2003 to reflect these new requirements. These requirements include limits for out-of-band and spurious emissions for radars and the boundary between them. In parallel with this the ITU has developed a study programme with design objectives for future radar systems. This programme is scheduled to complete in 2006.

22. The design objective is to make more severe the out-of-band emission limits for radar systems. If the outcome is agreed it could reduce the spectrum occupancy of some radar systems. The study will also include an examination of the applicability of the out-of-band limits within exclusive radiodetermination bands.

23. The International Electrotechnical Commission (IEC) has developed test and conformity standards for IMO shipborne radars, based upon the current IMO performance and ITU emission standards. It has now set up a Working Group to study future technology maritime radars that conform to IMO requirements. It is taking into consideration the current and possible future ITU emission requirements and the possibility that IMO will amend their requirement to detect SARTs and RACONs. The IEC has also set up a Working Group to develop test and conformity standards for small boat radar systems, incorporating the ITU unwanted emission limits.

THE FUTURE OF SPECTRUM MANAGEMENT

24. As the economic value of radio spectrum has been increasingly recognised, the way spectrum is viewed as a resource has changed for ever. This presents a number of challenges for the maritime community.

25. Two recent initiatives have highlighted the Government's desire to give wide access to a choice of diverse communications services and to scrutinise how spectrum is managed.

They are:

- the White Paper "A New Future for Communications" which proposes the setting up of a new unified regulator for the communications sector – OFCOM; and
- the independent Review of Radio Frequency Spectrum Management under Professor Martin Cave.

In the light of these initiatives the MCA has reviewed the maritime use of radio spectrum.

26. The MCA recognises that surrendering spectrum that is no longer required and ensuring the maintenance and correct usage of equipment are ways in which mariners and coastguards can ensure best use of the spectrum. The application of pricing may also have a role to play.

27. Improvement of current technologies, by, for example, using digital techniques to get more out of the spectrum and reduce out-of-band interference, may also have a role to play. However, this is a longer-term strategy. Manufacturers are understandably reluctant to develop new techniques and equipment if they cannot see a market for it. Spectrum pricing is one way of creating that demand though it can take years for these drivers to deliver new technology to the marketplace.

FUTURE STRATEGY

28. As far as the MCA's own consumption of spectrum is concerned, it has given an undertaking to: -

- release spectrum as and when it is no longer required for HM Coastguard operational activities;
- take all reasonable steps to operate in a spectrum efficient manner including the use of sharing;
- be responsive and proactive in eliminating interference to other services from MCA installations and be in compliance with regulations;
- continue to play a positive part in spectrum planning at a national and international level; and
- continue to develop a constructive and co-operative relationship with the Agency and other agencies, being as open and informative as possible.

29. In return, the MCA and the UK maritime community look to other agencies, and in particular the RA/OFCOM, to: -

- recognise and take account of the needs of the maritime community for reliable communications for navigation and distress alerting;
- recognise and take account of the MCA's national and international obligations for the following activities - promoting safety of life at sea through

GMDSS, supporting a search and rescue capability, participating in Cospas-Sarsat activities as a ground segment provider and providing a counter-pollution capability;

- help ensure that the legitimate activities of the MCA in protecting life and the environment are not compromised by failure on the part of others to comply with regulations on the use of the radio spectrum;
- take account of the differing operational characteristics of radiocommunication and radar when considering spectrum usage; and
- be open and communicative about activities and proposals that may impact the maritime community and the MCA.

CONCLUSION

30. The MCA has always played an active role in national and international spectrum planning, working closely with the Agency, and will continue to do so. The MCA's policy on spectrum management remains one of positive engagement with other governmental bodies particularly the Agency with whom the MCA wishes to continue building a constructive relationship. The MCA will also continue to represent the interests of the UK maritime community to the wider family of spectrum users seeking practicable solutions that meet the needs of seafarers.

CHAPTER 6

SPECTRUM MANAGEMENT MECHANISMS

BACKGROUND

Chapter 1 outlined the Agency's goals and objectives in developing a coherent and joined-up Spectrum Strategy. The institutional arrangements and, particularly, the administrative tools which are used to manage the spectrum both in the UK and at the international level, are important factors in shaping our strategy. This important subject is the main focus of the independent Review of Spectrum Management[9], led by Professor Martin Cave, referred to in Chapter 1.

2. This chapter outlines our current procedures, the changes which have been implemented over the past few years, and those which are currently planned or foreseen. Professor Cave's report has endorsed the general direction of our approach and has recommended further changes which could have significant implications for our future practice. As explained in Chapter 1, the Government's response to the Review will be published in the summer.

THE UK POSITION

Assignment and Licensing

3. The Wireless Telegraphy Act 1949 (the 1949 Act) has for many years provided the primary mechanism for spectrum management at the assignment level. Under it, the use of radio equipment and apparatus in the UK is required to be authorised by the Secretary of State. The current arrangements for licensing and licence exemption are described in more detail in Chapter 7.

Spectrum Allocation

4. The UK Spectrum Strategy Committee (UKSSC), an interdepartmental Cabinet Office Committee, provides the official forum for formulating the policy governing the planning and allocation of frequencies. It is jointly chaired by the Agency and the Ministry of Defence (MoD), because the allocation of spectrum for civil radio services is the responsibility of the Agency, while the management of military spectrum is the responsibility of the MoD. The other Government Departments mentioned in 1.2.4 are also represented on the UKSSC.

5. The UKSSC's subordinate committee structure includes the National Frequency Planning Group (NFPG) and the International Frequency Planning Group (IFPG). The NFPG is responsible for maintaining the national frequency allocation tables and considering all proposals for change. The IFPG concentrates on the preparations for ITU World Radio Conferences (see para 6

[9] *Review of Radio Spectrum Management*: March 2002

below) and its membership extends beyond Government to include major operators, broadcasters, industry and other interested parties.

THE INTERNATIONAL DIMENSION

6. Since radio waves do not stop at national frontiers, the need for international planning of frequency allocations and protection of the legitimate use of radio spectrum has long been recognised. On the global level, the task falls to the International Telecommunication Union (ITU) which is part of the United Nations family. ITU agreements on spectrum allocation are set out in the ITU Radio Regulations (ITU RR) which have treaty status. The Radio Regulations regulate the use of radio spectrum internationally and form the global framework for regional and national planning (although nations remain sovereign in their use of the radio spectrum in their own territory and Article 48 of the ITU Constitution states that ITU members may retain their freedom with regard to military radio use). The Radio Regulations are regularly revised through World Radio Conferences, which take place every 2-3 years.

THE EUROPEAN LEVEL

7. More detailed spectrum planning is conducted at the European level through the Electronic Communications Committee (ECC) of the CEPT (European Conference of Post and Telecommunications Administrations) which currently has 44 member countries. Frequency allocation issues are handled through the Frequency Management Working Group (FM) and there are also committees dealing with Radio Regulatory (RR) and Spectrum Engineering (SE) issues. The current ECC structure is shown in Appendix E. This was significantly changed in October 2001 when the responsibilities of the radio and telecommunications sides of the CEPT, previously handled separately, were combined in a new Electronic Communications Committee (ECC). Under the new institutional arrangements it is intended that the CEPT Assembly should take on a new role of ensuring high level strategic co-ordination between CEPT members. There will also be a strengthened role for the CEPT Presidency, including the establishment of a troika, consisting of the immediate past, present and next presidencies, in order to ensure greater continuity and coherence. The UK took on the CEPT Presidency on 1 October 2001.

8. Each of the ECC's three main working groups (FM, RR and SE) also has a number of project teams which are charged with detailed examination of specific areas. The ECC produces Reports, Recommendations and Decisions on spectrum usage. When implemented by member countries, these form the basis for European harmonisation of spectrum usage at the allocation level.

9. The ECC co-ordinates long-term spectrum planning in Europe and has produced the European Common Allocation Table (ECA), a harmonised frequency table for Europe covering all of the usable spectrum. The ECC also provides the forum for co-ordinating European preparations for WRCs through its Conference Preparatory Group (CPG).

10. The European Union is also playing an increasingly important role in the field of spectrum management. To date, this has mainly been focused on the adoption of certain common legal requirements for spectrum assignment and authorisation (see Chapter 7). However, the EU has also adopted spectrum harmonisation measures. In the early 1990s, three frequency harmonisation Directives were adopted, on GSM, DECT and ERMES. Unlike ECC Recommendations and Decisions, these Directives are binding on Member States. The advantage of this approach is that it provides certainty for operators that spectrum will be made available for specific services. The disadvantage is that where there proves to be no commercial interest in providing the service concerned (as in the case of ERMES) the spectrum is effectively sterilised for other possible uses.

11. In 1992, it was agreed, in EU Council Resolution 318/01, that European spectrum harmonisation should normally be carried out through CEPT and that EU Member States should commit themselves to full participation in the development and implementation of ERC/ECC Decisions. Subsequently, other spectrum management measures have been adopted at EU level, most significantly, the UMTS Decision (128/1999), which have mandated CEPT to adopt binding frequency harmonisation measures. The EU Spectrum Decision (see Chapter 7) will represent a further extension of EU activity into the field of frequency harmonisation.

RECENT DEVELOPMENTS

12. Until recent years, the traditional regulatory approach of spectrum management, built on the structure of global and European harmonisation has worked well and, in many cases, continues to do so. However, over the last 10 years or so there has been a massive increase in the demand for radio spectrum and major changes in the patterns of its use, as outlined in Chapter 1. In the light of this, it has been necessary to re-examine traditional methods of spectrum management.

13. In the UK, an important milestone was publication of the 1996 White Paper: *Spectrum Management: into the 21st Century*. This discussed the need for significant changes and set out proposals for the introduction of spectrum pricing, the selective use of auctions, and, in the longer term, spectrum trading. The proposals outlined in the White Paper were implemented in the Wireless Telegraphy Act 1998 (the 1998 Act) which provided new mechanisms to enable the Secretary of State to use licence fees to help manage supply and demand for the use of radio spectrum. It also enabled auctions to be used as a spectrum management tool.

14. Before the 1998 Act, the licence fees charged by the Agency were broadly set at a level to enable the Agency to cover its administrative costs, sector by sector. The Act provided powers for Secretary of State to charge higher fees for spectrum management purposes, taking into account the factors outlined in Section 2 of the Act which include such matters as spectrum availability, demand and likely future demand, the promotion of efficient spectrum use, innovation and competition. Following the introduction of the new legislation four annual sets of

regulations have now been made to implement what has become known as administrative pricing. These are detailed in paragraph 18 below and Appendix D.

Auctions

15. During the passage of the 1998 Act, Ministers emphasised that auctions would be used selectively, most probably for new national or regional services, where there were more applicants for licences than could be accommodated in the available spectrum. The first UK auction under the new powers, for Third Generation Mobile licences (IMT2000/3G), took place in March and April 2000. There were 13 bidders competing for 5 licences. The award of 28GHz broadband fixed wireless access regional licences by auction followed in November 2000. As some of those licences were not assigned a further award process for the remaining licences was launched in October 2001 (for details see the Agency website: http://www.radio.gov.uk – Fixed Wireless Access). Competitions for further fixed services are planned (see Chapter 2 - Fixed Wireless Access for further detailed information).

16. There has been much debate about the use of spectrum auctions in the light of the high sums bid for third generation licences in the UK and also in Germany and the subsequent financial downturn of the telecoms sector. The UK Government takes the view that, in general, where there are likely to be more applicants than the spectrum can accommodate, an auction provides the fairest, most transparent and most effective means of assigning licences to those operators that are likely to value them most. The Government also believes that the use of any alternative administrative selection mechanism for 3G licences would have been extremely problematic, given the large number of applicants. In these circumstances, auctions have considerable advantages of speed, and above all, transparency and objectivity, as compared to the alternative of comparative selection or "beauty contest". This view has been endorsed by the National Audit Office in its report on the 3G auction[10] and by the independent Review.

17. The Government's view remains that auctions are a useful spectrum management tool to be used in appropriate circumstances, particularly where spectrum is being assigned for a new service and where demand is expected to exceed the supply of available spectrum packages. However, the use of other methods of selection, including comparative selection, will always be considered to ensure that the best tool is selected to achieve the Government's objectives.

Spectrum Pricing

18. Administrative spectrum pricing was first introduced though the Licence Charges Regulations of 1998, and has been progressively phased in at annual intervals for existing services and for first-come, first-served or shared spectrum use. The Agency's *Spectrum Pricing: Third Stage Update and Consultation* document issued in December 2000 provided full details of the principles, the phasing and the actual fees proposed that came into effect in July 2001. It is

[10] *The Auction of Radio Spectrum for the Third Generation of Mobile Phones,* Report by the Comptroller and Auditor General, HC 233 Session 2001-2002, October 2001.

anticipated that there will be further Regulations in 2002 and 2003 to continue this process. The Agency's proposals were set out in its Consultation Document of January 2002; *Spectrum Pricing: Year Five*. Appendix D provides a sector by sector overview of progress towards implementation.

19. The independent Review has endorsed this approach. The review has strongly endorsed the underlying premise of spectrum pricing - that users facing a charge which reflects as fully as possible its marginal value will tend to make efficient use of spectrum. It has recommended that it should be applied, so far as possible, to all classes of spectrum user. The Agency will need to consider, in the light of consultation and the Review's recommendations, what pricing steps are necessary after the conclusion of the first implementation for each appropriate sector.

Spectrum Trading

20. Spectrum Trading is the term broadly used to describe a process for enabling licensees to transfer their licences to other parties. From the experience of those countries that have already introduced spectrum trading, and from examination of trading in other markets, it is clear that it must be implemented within an appropriate regulatory framework and that a wide range of options are possible, but not necessarily all desirable. For example, at one extreme a regulatory regime can restrict spectrum trading to sale and purchase of certain types of whole licences only with no change of use permitted. At another extreme, a regulatory regime can allow a wide range of activities including partition of licences (sub-division by geography or frequency), aggregation of licences, short-term loans of portions of rights provided by licences, longer term loans, loans until particular events occur (pre-emptive loans) and various degrees of change of use or change of technical standard. Of course there are many intermediate states. Properly implemented trade should lead to gains for the economy as a whole, with each trade taking place only when both seller and buyer will experience a gain from trade. If either party is disadvantaged then no trade will exist.

21. A key feature of a spectrum trading environment is that no licence holder is forced to trade. It is considered that freedom to trade spectrum will enable market mechanisms to be applied more effectively than their application solely at the point of initial assignment and will thus encourage better overall spectrum efficiency and utilisation, making it easier for entrepreneurs to quickly acquire the spectrum that they seek. Of course, it is important that regulatory oversight ensures that competition is not distorted, and that mechanisms are put in place to ensure that spectrum markets work well. A spectrum market that works well should:

- improve the economic efficiency of spectrum management;
- help to ensure that spectrum is assigned to those who can produce greatest benefit from it, and
- provide flexibility for assignments to be adjusted through the market in response to changes in demand.

Spectrum markets will always be subject to the principle that spectrum set aside for essential public services may not be appropriate for trading.

22. The possible introduction of spectrum trading in the UK was first mooted in the 1996 White Paper, and views were invited on it in the Agency's 1998 Consultation Document: *Managing Spectrum through the Market*. The Government's commitment to introducing trading was reaffirmed in its White Paper of December 2000: *A New Future for Communications*.

23. The independent Review has strongly endorsed the findings of the 1998 Review in supporting the introduction of spectrum trading in the UK. It has recommended that spectrum trading should be introduced in the UK as soon as possible and that the trading regime should be designed to minimise the transaction costs of trading. It has also suggested that the way spectrum use is registered, monitored and enforced would have to change with more emphasis being given to defining tradable rights and to how information about spectrum use is recorded and published.

24. The Agency is in the process of preparing a detailed consultation document to explore these issues in much greater depth. No decisions will be taken before this process is completed or before Ministers have considered responses to the Independent Review; and there will be further consultation in due course on the detailed trading rules for each sector. The new Directives adopted in February 2002 under the EU's Communications Review have removed the previous legal impediment to spectrum trading. Article 9 of the Framework Directive[11] permits Member States to make provision for undertakings to transfer rights to use radio frequencies, in accordance with procedures laid down by the Member State, subject to safeguards against distortion of competition.

Spectrum Refarming

25. One of the most challenging issues facing the Agency is how to enable frequency bands to be realigned or reassigned for new types of use. This is not a new problem. For example, in the past, broadcasting in VHF television bands I, II and III was ended in order to reallocate the spectrum for mobile use. Some private mobile radio bands were re-located to make way for the ERMES Digital Paging Service, following adoption of the EU directive. The procedure followed by the Agency in all these cases was to give users several years advance notice of licence termination and offer them a choice of new assignments in alternative channels. This was accompanied by a publicity campaign through trade bodies and local dealers, followed up by the Agency's regional staff. This was a slow process and expensive in terms of resources.

26. The 1998 Act gave the Secretary of State new powers to make grants to encourage spectrum efficiency. One use of these powers can be to make grants to accelerate the process of spectrum refarming. Individual uses will need to be approved by the Treasury and justified on value for money grounds.

[11] Directive of the European Parliament and of the Council on a Common Regulatory Framework for Electronic Communications Networks and Services, 2002/21/EC

27. The Agency is considering the possible use of these powers to accelerate the proposed realignment of mobile spectrum in the UHF bands (see Chapter 2 - Private Mobile Radio) and for dealing with the programme–makers affected by the re-alignment of the 3.4 GHz band for Fixed Wireless Access.

28. It is possible that, in the future, spectrum trading could help to bring about a limited degree of refarming if, for example, a purchaser of spectrum were able to provide a different service from that provided by the original licensee. This is a complex issue and a number of questions need to be resolved, in particular, the possible impact of a change of service on other users, and compliance with international allocation agreements. This is one of the major issues addressed in the report of the independent Review.

CHAPTER 7

THE AUTHORISATION OF SPECTRUM USE

CURRENT POSITION

1. Most radiocommunications networks and services are licensed under Section 1 of the Wireless Telegraphy Act 1949 (the 1949 Act). However, low power services are increasingly being exempted from licensing through Regulations which can be made under the Act, provided that the apparatus or equipment used complies with the Regulations. Government users require no licence but most of their services are now subject to equivalent agreements with the Agency.

LICENSING

2. Section 1 of the 1949 Act gives the Secretary of State the power to issue licences to persons (including corporate bodies) to use wireless apparatus or equipment subject to the terms and conditions in the licence. For administrative convenience, the Agency has generally grouped its application forms, licence requirements, charges and common terms into a set of products covered by specific licence "classes" (for example Aeronautical Ground Station, Fixed Radio Relay Link). These licence classes are further grouped into business sectors (for example Aeronautical, Fixed Services), under which they are managed. Details of the numbers of licences issued by class are contained in the Agency's Annual Report. Currently, there are over 240,000 extant licences.

3. It has been noticeable in the last few years that, whilst there has been substantial overall growth in the number of licences issued, this has been most marked in the classes related to public systems. Indeed recent evidence has shown some reduction in demand for private licences (Amateur and CB down by 6%, PBR licences down by 4%). However, in the PBR sector smaller systems are declining whilst the larger networks (measured by the number of base stations) continue to grow. By contrast the number of new public systems, and supporting infrastructure demand (ie fixed link licences) has grown steadily so that the number of stations and links licensed grows each year.

4. For each licence class there is a common application form and set of conditions. A list of sectors and classes is published in Information Sheet RA 2, along with details of how to apply. Through the Wireless Telegraphy Licence Charges Regulations, the Secretary of State determines the fees chargeable for each class of use. Unless there has been a competition for use of spectrum (see paragraph 6 below), nearly all licences are issued on a first-come, first-served basis. Licence fees are chargeable on issue of the licence, and in most cases at annual renewal intervals thereafter. Most licences are normally open-ended,

although the Secretary of State may revoke a licence for non-payment of fees, misuse or abuse of the radio system.

5. Sometimes a band may need to be cleared for a new use. The Secretary of State may then need to revoke existing licences in the band. In these circumstances it is the Agency's policy to endeavour to give the maximum possible notice of the intention to revoke a licence and to point users towards alternative bands and licence class options where possible. The issue of refarming strategy is discussed in Chapter 6.

6. Where the number of potential applicants exceeds the available supply of spectrum the Secretary of State may determine that a licence shall be awarded by competitive means. This also applies in relation to the provision of spectrum linked to broadcasting rights under the Broadcasting Acts, where the selection procedure would be conducted by the appropriate broadcasting authority. Providers of public telecommunications services may also need to comply with licensing conditions under the Telecommunications Act licence, issued by the DTI. Over the last decade there have been a number of awards made jointly under the Wireless Telegraphy and Telecommunications Acts for services such as second generation mobile telephony, national paging and data networks. These have been done on the basis of comparative selection against set criteria (the so-called "beauty contest").

7. As described in Chapter 6, The Wireless Telegraphy Act 1998 provided new powers for the Secretary of State to auction licences. This power was first used to issue licences for third generation mobile telephony and later for broadband fixed wireless networks. In contrast with other licences, the auctioned licences have been issued for a fixed number of years, with no further fees payable.

Licence Exemption

8. Licence Exemption Regulations were initially used to cover low power wireless use. Such devices include model controls, garage door openers, car keys, and many other kinds of short-range signal equipment. The Exemption Regulations set out the frequency, maximum power and other conditions with which use of any such devices must comply.

9. More recent Regulations have extended exemption to further types of service. These have included domestic cordless telephones, mobile terminals for satellite communications and some short to medium-range devices such as the PMR 446 hand-portables, which utilise a European common frequency band and equipment standard. Exemptions for these services, which have more potential for interference, have been permitted by the adoption of common standards (often European-wide) and more intelligent technology, sometimes working in conjunction with control signals from licensed networks- as is done with mobile telephony. Thus large numbers (i.e. many millions) of wireless devices may be used without licences.

10. An issue which the Agency is considering is whether the provision of public services should be permitted in licence-exempt spectrum. This would be in the spirit of the new approach to authorisation in the new EU Directives (see

paragraphs 13-16 below), but raises difficult issues about whether increased numbers of users could lead to congestion and interference, and about competition with licensed service providers. Currently the use of low power technologies such as DECT to provide public networks does require a licence whereas private domestic use is exempted. However, licence exempt services are not afforded protection from interference arising from other authorised services. The growth of new networks either using or planning to use the 2.4GHz and 5 GHz bands for linking wireless computer networks has focussed this debate sharply. The issue also has implications for Telecommunications Act licensing which requires additional safeguards for public services. The issue is discussed further in Chapter 1. As explained in Chapter 2 the Agency issued a Consultation Document on this subject: *Consultation on the Licence Exempt Use of Spectrum for the provision of Public Telecommunications Services* in October 2001 and is currently considering the next steps in the light of the comments received.

R&TTE DIRECTIVE

11. For many years there was a regime of type approval with which most radio equipment had to comply, irrespective of whether it was licensed or exempted. Manufacturers and installers had to ensure equipment met the appropriate type approval before it could be used in the UK. The type approval standard was specified in the licence conditions or Exemption Regulations.

12. In 1999 the Radio Equipment and Telecommunications Terminal Equipment Directive (1999/5/EC) (The R&TTE Directive) came into effect, bringing about a significant change in that Member States are no longer able to set national equipment standards (see information sheet RA 368). Under the Directive it is the responsibility of manufacturers or importers to ensure that equipment does not cause harmful interference and that users are provided with information on its intended use. The Agency now publishes Interface Requirements for each class of licence (details of which are available on the Agency's website) to establish the range of equipment characteristics appropriate to that class or exemption. The aim of the Directive is to enable free circulation of compliant equipment within the Community.

LICENSING DIRECTIVE

13. European legislation now has a significant impact on UK licensing procedures. In the field of telecommunications radio, the Licensing Directive (97/13/EC) was the first major initiative to harmonise practice across the EU. The Directive has not changed the Secretary of State's power to issue licences or exemptions, but it has formally required the Agency (acting for the Secretary of State as the UK Regulatory authority) to act fairly, proportionately and transparently in taking licensing decisions. The Directive has, in fact, complemented the steps we were already taking to increase the transparency and visibility of our licensing and spectrum management processes. These include a significant increase in the range of published information and wide consultation before taking decisions about licensing or setting new licence fees.

THE 1999 REVIEW

14. In 1999 the European Commission started a very wide-ranging review of all communications legislation. They considered that the Licensing Directive was not working consistently across all Member States and that the current regulatory regime needed major updating to take account of convergence.

15. In July 2000 the Commission therefore brought forward a suite of new draft Directives and Decisions. These included a Framework Directive with supporting Directives on Authorisation, Access and Interconnection, Universal Service and Data Protection and Privacy. They also proposed a Spectrum Decision (see paragraph 17) and a Local Loop Unbundling Regulation. The key measures in the package, including the Framework and Authorisation Directives and the Spectrum Decision were finally adopted on 14 February 2002.

16. Authorisation of radio services is primarily affected by the terms of the Authorisation Directive, which is subject to the general principles of the Framework Directive. The main effect of the changes will be to put more emphasis on justifying the need for licensing. Specific individual authorisation (such as licensing) will only be allowed if objectively justified in terms of the need to avoid harmful interference. Otherwise a general authorisation will be required (on the lines of our Wireless Telegraphy Exemption Regulations). The Directive also requires that conditions attached to licences for use of radio spectrum shall be limited to those directly relevant to good spectrum management.

SPECTRUM DECISION

17. The Spectrum Decision, which will come into force very shortly (following publication of the final text in the Official Journal), primarily concerns the arrangements for spectrum allocation rather than licensing and assignment. Its main effect will be to permit the Commission to adopt delegated harmonisation measures, using comitology procedures (where measures will be adopted through a committee of Member States, rather than through the European Parliament and Council of Ministers). However, this will only apply to “technical implementing measures” necessary to give effect to a policy which has been agreed through the Council of Ministers and European Parliament. The Decision will also require Member States to publish information on national frequency allocations and other information relating to the use of radio spectrum, including such matters as licensing conditions, application procedures, and licence fees. As explained in paras 24-26 below, we believe that the UK already fully meets these requirements.

Impact of the new Directives on the Agency

18 The Directives will continue to permit spectrum pricing and competitive licensing procedures (including auctions) to be used for spectrum management. More specifically, as explained in Chapter 6, the new provisions will permit the

introduction of spectrum trading. The Directives will come into effect 15 months after their publication in the Official Journal. In the light of their requirements the Agency will need to:

- ensure that all licence classes are necessary and consider the scope for making more use of exemptions;
- consider whether it is possible to have licences that are less equipment focussed, given that the Directives concern "authorisation of frequencies";
- revisit licence terms and conditions to ensure they reflect the minimum necessary and to ensure the duration of a licence is clear and proportionate;
- continue to review our overall presentation of information about frequencies and access to them, to ensure maximum clarity, and to explain any limitations in the number of licences;
- continue to consider the whole issue of licence transparency. We are currently consulting about the possibility of making licence information and assignments more generally accessible to industry and the public; and
- review our appeals and complaints procedures.

19. Another issue arising from both the R&TTE Directive and the Communications Review package is the potential deregulation of further bands using harmonised equipment. As explained in Chapter 2.16, the Agency is consulting on whether it is possible to exempt public systems in bands where private systems are already exempt. For instance DECT public networks are required to be licensed whereas private DECT links are not. This issue is also pertinent to the roll-out of new bands for Radio Local Area Networks (RLANS) as used for computer networks. The issue is discussed in more depth in Chapter 1.

e-licensing

20. Over the last 5 years the Agency has made substantial new investment in information systems to support licensing and pricing. In particular, the RULES system has put all the licences managed directly by the Agency onto a common database. The Government has now set targets for the on-line delivery of Government services by 2005.

21 Considerable progress is already being made in developing an e-licensing strategy, building on the initial work done on RULES. Initial work on pilot facilities for licensing Fixed Links and Paging has proved successful, and facilities will be extended progressively to all licence classes. Whilst the initial focus has been on application and delivery of licences, the strategy has gone much wider. The key themes are:

- provision of a spectrum information portal for both industry use and to meet public interest about mast sites
- on-line licensing, including full automation for simple licences
- development of an on-line assignment facility
- on-line clearance for installation of sites for major networks and satellite temporary earth stations.

22. The strategy also includes an e-licensing facility for licences provided by the Agency's contractors who issue licences for Amateur, CB, Ships and Programme Making. As explained in Chapter 4, aeronautical licensing has been delegated to the CAA to ensure that their customers have a single contact point for aviation issues, including radio. All these contractors will be required to offer on line services. A significant issue will be encouraging take up by private individuals, who account for a significant proportion of customers in these classes.

23. A major issue underlying the e-strategy is the concept that customers will look to the Agency to provide a menu of licensed applications and information about spectrum use, but be able to take an informed decision on assignments. This is supported by the moves to make licensing and assignment data more transparent, and the development of a self-assignment on-line facility.

PUBLICATION OF ASSIGNMENT INFORMATION

24. The Agency currently publishes detailed information on spectrum allocation through its published allocation tables and through the Spectrum Strategy. We believe that no other major spectrum-using country goes further in this direction and that our existing practice fully meets the transparency requirements of the proposed EU Spectrum Decision. In addition the Agency is actively participating in the development by the ERO of a frequency database known as EFIS (European Frequency Information System) which contains frequency utilisation information from all Member States and will permit users, the public and administrations to view and compare frequency utilisation across Europe.

25. The Agency is also considering to what extent it should go further than this and publish information on spectrum assignments. This work has been driven by two requirements in particular. The first is the need to provide information publicly on mobile phone sites, following the publication of the Independent Report on Mobile Phones and Health which recommended that a national database should be set up by Government giving details of all base stations and their emissions. A project to compile a publicly accessible database of mast sites called Sitefinder through the Agency website was completed in October 2001.

26. The second major strand of this issue is the industry's wish to have more detailed information for its own planning purposes. However, this wish needs to be balanced against concerns expressed by some users that publication of assignment details could have confidentiality implications, particularly for businesses in sensitive sectors such as security.

27. Following discussion with a sub-group of the Agency's Mobile Services Committee, a consultation document: *Disclosure of Wireless Telegraphy Licence Information on Radio Frequency and Assignment Use* was issued by the Agency in January 2002 and comments invited by 12 April. The Agency will consider the next steps about disclosing information, once it has considered comments received from the public consultation process.

CHAPTER 8

RESEARCH

INTRODUCTION

1. The Agency undertakes a substantial programme of contracted research in direct support of the Agency's regulatory functions and in support of its international activities by progressing a programme of radio-related research that promotes more efficient use of the spectrum and the development of new technologies. This work also supports the DTI's Science and Innovation Strategy and its objective of making the most of the UK's science, engineering and technology.

2. The Engineering and Research Unit (ERU) provides technical support to the Agency and manages the Agency's research programme which consists of research projects and some short-term studies. The ERU has a budget of around £4 million per annum to support this activity. There is a Technical Forum (TF) which allocates this budget to research projects. Staff in the ERU manage the budget, provide secretarial support to the TF and act as project officers for TF-funded programmes.

3. The ERU and the TF are advised by the Radio Research Advisory Committee (RRAC) on the overall direction of the Agency's research strategy and on specific proposals. The RRAC comprises external experts in radio communications technology and systems (a list of RRAC members is shown in Annex 1).

4. While much of the Agency's research programme is contracted out, some projects are carried out at the Radio Technology and Compatibility Group (RTCG), located at Whyteleafe, Surrey. The RTCG is staffed by specialist radio engineers who operate a well-equipped laboratory and provide support to other parts of the Agency.

THE RESEARCH REVIEW

5. Two years ago a research review was conducted in consultation with representatives of industry, academia, representative bodies, such as IEE and RSGB, and Government Departments. A number of the recommendations have been implemented, leading to a realignment of research activity to more directly support spectrum management and a top-down approach for a research strategy.

The Review's Recommendations

6. The Review recommends that the research programme should be refocused:

- to achieve greater use of existing spectrum through the use of more efficient or new technology;
- to identify suitable measures of performance and spectrum efficiency;
- to establish the RRAC to advise the Agency on its current research programme; and
- to introduce competitive tendering for projects and further project evaluation.

7. The review recognised the benefit of long-term core programme research, but emphasised the need to frame this in a new convergent technology context. Other supporting recommendations focused on performance, collaboration and dissemination of data.

RESEARCH STRATEGY

8. The development of a cohesive long-term spectrum strategy is vital for the UK, and the RRAC recognises that the research strategy can be a means of helping to deliver this. The research strategy is now driven by the Agency's spectrum strategy. To this end the RRAC has reviewed the Agency's research programme (based on internal and external research programmes covering propagation, EMC, Mathematical programme, sharing studies, and other technology areas.) and recommended a research strategy built around four main elements:

- improvements in current use of spectrum;
- sharing and coexistence studies;
- spectrum efficiency issues, and
- forward research and technology benefits, including extending the usable frequency range.

9. These elements need to be underpinned by fundamental radio science and radio wave propagation data. A further key element is to prioritise projects in terms of short, medium and long-term research.

10. It is particularly important to develop "blue-sky" research as well as the conventional co-existence studies, EMC and interference reduction work. Conducting early long-term research (be it propagation studies to improve link performance or work towards roll-out of systems beyond 3G and new software defined radio systems) will support the objectives of good spectrum management practice.

11. As well as providing a strategic top-level view in this area, the RRAC proposes to comment on potential methods of evaluating research projects and

consider ways of taking account of the economic dimension in defining, implementing, and measuring the benefits of individual research projects. The Committee believes that the highest priority should be given to accommodating new services whilst ensuring that the two future significant Telecommunications growth areas, namely 3G/IMT-2000 and Broadband Fixed Wireless Access (BFWA), are supported by the necessary research programmes. From this standpoint the RRAC have recommended several key issues warranting short-to-medium term research and also a number of areas for longer term research.

12. The short-to-medium priority research issues come under four headings as follows:-

- **Accommodating new services**;
  - support 3G/IMT-2000 and BFWA

- **Better use of existing spectrum**;
  - metrics for spectrum efficiency
  - network interoperability (operator support) and ad hoc networks
  - EMC issues and automatic detection/logging of illegal use

- **Sharing studies (e.g. radar bands) and EMC issues**;
  - software radio and networks
  - potential sharing in radar bands
  - database on spectrum -related research activity (UK, Europe)

- **Research exploiting use of higher frequencies, beyond present stage**
  - analyse timescales for new technology implementation
  - mobile type services in the 1 to 5 GHz band and the need for use of higher bands
  - maintain and expand the Task Groups.

13. For longer term research a number of issues were identified under three main headings:-

- **Spectrum efficiency**
  - ultra wide band technology
  - multi-antenna systems
  - radio system simulation

- **Studies/theory**
  - software and smart agents (software defined radio)
  - maximum usable propagation frequencies for urban environments
  - spectral sharing for very high user rates (>>2MB/s)
  - broadcast delivery by satellite or fibre with refarming implications

- **Convergence**
  - wide area cellular networks encompassing PMR
  - MSS future requirements
  - QoS with respect to peak and off-peak delivery
  - picocell, microcell and application to location information.

14. RTCG is taking a proactive approach to investigate new technology trends and considering how these may impact radio systems and highlight potential interference issues. These findings will be fed back to the Agency in the form of reports and a discussion list.

15. RTCG provides a technical resource to supply engineering solutions to a wide range of compatibility and interference related issues. These focus particularly on new and emerging radio systems and services and their interaction with existing services. RTCG has undergone an extensive modernisation programme during the last year and this, together with its ongoing test equipment replacement schedule and advanced computer simulation techniques, enables it to complement the external research work supported by the Agency.

16. Looking further ahead, the RRAC has identified key bands, and areas such as broadcasting band re-alignment, along with the increased use of higher frequency bands, where long-term changes are needed. It may also consider mechanisms to identify spectrum occupancy and use as a measure of "spectrum efficiency" in a range of frequency bands. Other issues of collaborative research and evaluation are being addressed. It will also be necessary in the future to consider how the Agency's research strategy can be further co-ordinated with the research needs of the other regulators who will make up the new unified regulatory body responsible for communications (OFCOM).

Annex 1

RRAC MEMBERS LIST

Mr Peter Kiddle OBE (Chairman)
Mr Chris Cheeseman
Mr Tim Cull
Prof Jim James
Dr David James
Prof Peter Ramsdale
Prof Ray Steele
Dr Gary Tonge
Dr Walter Tuttlebee
Prof Peter Watson

Agency Members:
Mr Barry Maxwell
Mr Mike Goddard

Secretariat:
Prof Trevor Clarkson
Mr Martin Skingley (Meeting Secretary)
Mr Chris Carey