Office of the Director of Telecommunications Regulation

RADIO

Strategic Management of the Radio Spectrum in Ireland

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Foreword

The telecommunications sector that the ODTR regulates, has transformed, and continues to transform almost every area of our lives – business, education, public services and leisure – at a pace that would have been unthinkable just five years ago. As the Irish economy and population expanded in the 1990s we became ever more conscious of the infrastructural deficits - in roads, in waste management, in electricity and in telecommunications, amongst others - and major efforts are underway or planned to respond to these needs. The management of radio spectrum has an important role to play in developing the national communications infrastructure.

Developments to date have already made a difference - for example, mobile phone coverage is wider than fixed line, offering a choice of voice services in most parts of the country. Availability of broadband is a particular concern: wireless systems both fixed and mobile have the potential to deliver high capacity services both on the move and to the home and office, adding competition in the last mile and most importantly bringing down prices and offering a diversity of choice to the consumer. The radio spectrum, which is essential to these innovations, is a finite resource, although generally not a scarce one in Ireland. There is, for example, relatively low spectrum use by security services in Ireland and our geographical location at the edge of Europe limits the level of international co-ordination required. However, pressure is growing with increased and also increasingly diversified demands especially for certain particularly useful spectrum bands. As the information society continues to develop rapidly, it is essential that the radio spectrum is managed effectively to ensure maximum contribution to national infrastructure. This involves forward planning and careful consideration of the implications of spectrum allocation to ensure that opportunities are not foreclosed or inadequately catered for, and that spectrum is assigned and used efficiently.

This document outlines the first spectrum management programme for Ireland. It has been carefully prepared following rounds of public consultation firstly on the current and future demand for spectrum (February 2001[1], the response to that consultation[2]) and then by issuing a draft of this paper in October 2001[3]). We have also taken account of the responses to other relevant consultations on spectrum use, in particular in relation to FWA and broadcasting transmission. We have also noted the provisions of the new Communications Regulation legislation. This document develops the objectives we strive towards, the intended strategy we are following to achieve those objectives and outlines key issues for spectrum use going forward. I would like to thank the parties who responded to the draft document on areas of interest to them and who put forward a number of suggestions that have been taken into account in preparing this publication. The opportunity has also been taken to update the text

[1] ODTR Document No. 01/06 Managing Spectrum Management – Planning for the Future – Consultation Paper
[2] ODTR Document No. 01/31 ODTR Radio Spectrum Management – Planning for the Future – Response to Consultation
[3] ODTR Document No. 01/81 Strategic Management of the Radio Spectrum in Ireland – Draft Publication

to take account of EU and national legislative changes and to sharpen the focus and drafting to assist readers.

This paper is largely about allocation issues, that is the allocation of spectrum to particular uses, rather than about assignment of spectrum to specific users. However, it may be useful to note a few key points about assignment which are referred to in Part A of this paper. Firstly, in line with national objectives in respect of economic and social development, and in particular infrastructure development, access to spectrum should be as easy and quick as possible, and should not be expensive. On a mechanical level, we have guidelines for all types of radio frequency licensing, and have developed a major IT programme, computerising frequency assignment and licensing, and are currently developing our on-line application process for the most frequently used services. For example, the processing time for standard radio link licence applications has improved from typically 3 months in 1998 to one week in 2002.

More broadly our approach means that, where possible, access should be licence exempt, and the ODTR favours the development of services which can operate without affecting other users in shared spectrum. Where specific assignment of spectrum is necessary and there is substantial availability of spectrum, it will generally be assigned on a first come first served basis. As noted above, there are a number of key bands for which we have heavy demand and we intend to introduce administrative pricing to deal with this congestion in a fair way. Where it is necessary to limit the number of licences, competitions need to be held. The best way to support national development objectives is by using comparative selection processes designed to meet national needs.

Where licence holders wish to sell their businesses, the ODTR operates a simple policy for licence transfer, concentrating on ensuring the full and effective take-over of the licence commitments by new owners, and the maintenance of competition. Where some or all of spectrum assignments are not being used, they are retrieved from operators in accordance with licence terms and re-assigned. In order to encourage innovation and development, the ODTR operates a test licence regime, which manufacturers and operators may use to test the technical capabilities of equipment.

My objective is to ensure that the radio spectrum is used in the best possible manner for the benefit of users of telecommunications services in Ireland. This document presents the framework within which radio spectrum can be used, outlines a picture of current uses and what we intend to do in developing its use to meet our objectives in the years ahead. It is the first document of its kind issued by the ODTR and we look forward to improving and developing it in future years. Your ideas on what we should do would be most useful and you will find information on how to contact us at the back of this document.

Etain Doyle
Director of Telecommunications Regulation.

1 INTRODUCTION

The ODTR seeks to ensure that Ireland has the necessary operational framework in place to maximise economic benefit from radio spectrum while protecting the needs of the wider community. Over the last decade mobile communications, which depends substantially on radio spectrum, has become one of the fastest growing industries. Developments in other spectrum-using services and technology such as digital broadcasting and satellite also have the potential to provide significant benefits to industry and consumers. Decisions about spectrum use have long term implications for the spectrum user, for the consumer, and for the Irish economy overall.

In developing this strategic framework for managing the radio spectrum, we are responding to three key drivers. These are:

1. The need for a clear, well-balanced strategy to maximise the impact that the use of the radio spectrum has on economic and social development, particularly in assisting in dealing with the national infrastructure deficit;

2. The need to ensure that spectrum is managed in a flexible, transparent way, with ever faster decision making and provision so that the challenges of convergence, increased mobility and ubiquity of services can be met effectively;

3. The desire of users as indicated in responses to ODTR consultation papers to have publicly available a radio spectrum strategy that:

    a. is informed by and informs spectrum management decisions at a European and International level;
    b. takes due account of likely future developments in communications and other spectrum using sectors;
    c. takes account of the requirements of Irish users and broader national objectives;
    d. provides users with information to make appropriate investment decisions.

2 LIST OF RESPONDENTS

The eleven respondents to the August 2001 draft publication were, in alphabetical order:

- Cork Wan
- Damien Mulley
- Digifone
- eircom Plc
- Ericsson Ireland
- ESB Telecoms
- Eutelsat
- Fort Corbenic Corp
- Global VSAT Forum
- It's TV Limited
- Visitor Based Networks

The Director wishes to express her thanks to everyone who contributed comments. With the exception of material marked confidential, the written comments of respondents are available for inspection at the ODTR office in Dublin. The comments have been reviewed and taken into account in preparing this final text.

3. USING THIS DOCUMENT

This document is comprised of four parts.

Part A is directed at senior decision makers who want a broad look at the important radio spectrum issues and developments affecting the industry. This section examines the economic impact of radio spectrum usage and market development drivers within the industry. This is followed by the eight broad spectrum management objectives which the ODTR believes are central to a balanced spectrum strategy, and eleven strategy guidelines employed to align the spectrum management strategy and philosophy.

Part B is useful as an introduction for spectrum users who need to understand the complex arena in which radio spectrum users and managers operate. This section details the Global, European and International framework in which radio spectrum management and users must function. This includes E.U directives, equipment standardisation, frequency usage harmonisation, compliance and enforcement.

Part C will be of particular interest to engineers and other specialists involved in the day-to-day management of the spectrum allocated to their specific service. This section concentrates on developments in all radiocommunication services dealt with by the ODTR. This includes specific spectrum management objectives for each radiocommunication service and spectrum strategy issues that have been decided or are under consideration by the ODTR.

Part D consists of three appendices that provide a review of the responses received on the draft spectrum strategy document, a glossary of terms and definitions used, sources of useful information, sources of documents and a list of relevant websites.

Two charts showing an overview of the radio spectrum and its usage are at the end of the document in A.

4. EXECUTIVE SUMMARY

The development of this strategic framework for managing the radio spectrum is a response to three key drivers, namely:

1. the need for a clear, well-balanced strategy for future use to maximise the impact use of spectrum has on economic and social development;
2. the need to ensure that spectrum is managed in a flexible, transparent way, with speedy decision-making to meet the challenges of convergence, increased mobility and ubiquity of services, and;
3. the desire of users to have a publicly available, well informed strategy which takes account of future developments and the requirements of Irish users and national objectives and provides users with information on which to base investment decisions.

Considering the economic impact of radio spectrum use and the need for Radio Spectrum Management, the overall objective of this initiative is to develop a Spectrum Strategy Framework which will establish guiding principles for managing the radio spectrum resource in Ireland's interest.

There follows a detailed listing of objectives which will be helpful to spectrum managers and users alike. It should be noted that they are compatible with the objectives underlying the new EU telecoms framework due to come into effect next year. This new EU Framework includes, amongst the key policy objectives and regulatory principles, the tasks of National Regulatory Authorities (NRA) which can be summarised as follows:

1. NRAs shall take all reasonable measures which are aimed at achieving the objectives (as outlined below). Such measures shall be proportionate to those objectives.

2. NRAs, in carrying out their regulatory tasks, particularly those designed to ensure effective competition, should wherever possible ensure that regulations are technologically neutral;

3. NRAs may contribute to the implementation of policies aimed at the promotion of cultural and linguistic diversity, as well as media pluralism;

4. NRAs shall promote competition in the provision of electronic communications networks, electronic communications services and associated facilities and services by inter alia:
   a. ensuring that users, including disabled users, derive maximum benefit in terms of choice, price, and quality;
   b. ensuring that there is no distortion or restriction of competition in the electronic communications sector;
   c. encouraging efficient investment in infrastructure, and promoting innovation; and
   d. encouraging efficient use and ensuring the effective management of radio frequencies and numbering resources.

5. NRAs shall contribute to the development of the internal market by inter alia:
   a. removing remaining obstacles to the provision of electronic communications networks, associated facilities and services and electronic communications services at European level;
   b. encouraging the establishment and development of trans-European networks and the interoperability of pan European services; and end-to-end connectivity,
   c. ensuring that, in similar circumstances, there is no discrimination in the treatment of undertakings providing electronic communications networks and services;
   d. cooperating with each other and with the Commission in a transparent manner to ensure the development of consistent regulatory practice and the consistent application of the Framework.

6. NRAs shall promote the interests of the citizens of the European Union by inter alia:
   a. ensuring all citizens have access to a universal service;
   b. ensuring a high level of protection for consumers in their dealings with suppliers, in particular by ensuring the availability of simple and inexpensive dispute resolution procedures;
   c. contributing to ensuring a high level of protection of personal data and privacy;
   d. promoting the provision of clear information, in particular transparency of tariffs and conditions for using publicly available electronic communications services;
   e. addressing the needs of specific social groups, in particular disabled users;
   f. ensuring that the integrity and security of public communications networks are maintained.

Consequently the ***broad spectrum management objectives*** which we believe are central to a balanced Spectrum Strategy are:

1. to promote and support the orderly development and efficient operation of radiocommunication systems and services to facilitate the rapid development of a competitive, leading edge telecommunications sector that provides the best in terms of price, choice and quality to the end user, attracts business investment and ensures ongoing social and economic growth;
2. to plan and manage the utilisation of the spectrum resource in accordance with both national and international legislation;
3. to facilitate the use of radio/wireless systems to reduce the national telecoms infrastructure deficit as identified inter alia in the National Development Plan;
4. to further optimise use of the spectrum resource by, for example, the adoption of advanced spectrum allocation and management techniques based on operational requirements, bearing in mind technical and economic viability;
5. to protect national interests when harmonising and co-ordinating spectrum utilisation with other countries and regional and international organisations;
6. to ensure flexibility and ease of access to radio spectrum in reaction to technological advances and market factors in order to leverage Ireland's competitive advantage in this area;
7. to support and promote innovation, research and development in new radiocommunication techniques, spectrum-based services and applications;
8. to co-ordinate and establish spectrum and radiocommunication policies and plans by widely consulting with all interested parties.

In addition a number of ***strategy guidelines*** have been adopted to align spectrum management strategy and philosophy. These are:

1. to plan and allocate the radio frequency spectrum, a finite resource, in order to advance the broad-spectrum management objectives adopted in this document;
2. to adapt the allocation of, and access to, the spectrum resource to provide spectrum that best meets the needs of the user and to facilitate new and innovative services;
3. to continue to place emphasis on efficient spectrum utilisation and conservation techniques as a requirement for existing and new services;
4. to encourage the use of spectrum efficient radio systems and the use of the most appropriate frequency band for the application in order to maximise spectrum usage in critical frequency bands;

5. to continue providing and protecting radio spectrum for public safety, emergency services and safety of life services in view of their vital role in the safeguarding of human life and property;
6. to review the current procedures with a view to bringing licence duration more in line with investment cycles, noting that a radio licence does not confer ownership nor a continued right to a particular radio frequency;
7. to endeavour to provide reasonable notice to inform users of any conditions or circumstances which could result in displacement of services or systems to other bands – however it should be recognised that this will not always be possible;
8. to continue authorising radiocommunication system trials and new technology experiments in frequency bands appropriate to the intended applications and subject to the availability of suitable spectrum;
9. to specify compliance with international agreements on frequency usage and technical standards as a requirement for spectrum access, recognising that these agreements are necessary for harmonious system operation, efficient spectrum management, spectrum utilisation, compatibility, competitiveness and avoidance of interference;
10. to consider arrangements for the introduction of Administrative Pricing in order to encourage efficient use of the spectrum, with the intention of bringing the demand for spectrum into equilibrium with its supply. Regulations for this purpose will be subject to the consent of the Minister for Public Enterprise;
11. to continue operating its consultation procedures in order to have the benefit of user and industry views when making decisions.

Spectrum Assignment

Firstly, in line with national objectives in respect of national and in particular infrastructure development, access to spectrum should be as easy, quick and inexpensive as possible. Starting in the summer of 1997, when guidelines for applications for radio links were issued, the ODTR has developed and placed on its web-site guidelines and standard application processes for all radio frequency applications. In 1998 the ODTR started work on a major programme of computerising and streamlining frequency assignments and licensing. Work is on-going in relation to the development of electronic licensing, however, this is unlikely to be available prior to the implementation of the EU Directives. Currently technical details for radio link applications may be submitted electronically to the ODTR and payments may be made by credit card and direct debit. In addition, technical calculations and interference analysis for fixed link assignments are automated.

As a result of this on-going process of computerisation the processing periods for all radio frequency applications have been reduced. For example, the processing period for applications for radio link licences has reduced from typically 3 months or more in 1998 to one week in 2002. . There are some 16,000 active radio frequency licences of which 11,200 are Business Radio licences, 4,400 are point-to-point and point to multi-point radio links and there are a further 400 miscellaneous licences including satellite Earth-stations and community repeaters.

Spectrum is generally assigned using one of the following techniques:

1. where systems can operate without unduly affecting other users (for example, short range devices) then access to frequencies should be on a licence exempt basis;

2. where specific assignment of spectrum is necessary and there is substantial availability of spectrum, it is generally assigned on a first come first served basis;

3. where demand exceeds supply the use of comparative selection procedures may be employed to assign the spectrum to specific users;

4. with increased demand in some bands the use of techniques such as administrative pricing is being considered.

Administrative Pricing

The increasing demand globally for access to radio spectrum and, in some countries, congestion in a number of key frequency bands has generated a requirement for a more dynamic spectrum management process. This has led to the development of new approaches to spectrum management including, among other things, the use of economic criteria as part of spectrum management policy and as an instrument for determining licence fee structures. Economic criteria can be used, together with other more traditional spectrum management tools, to improve the efficiency of spectrum management and allow the radio spectrum to be managed on a more equitable basis for the benefit of all radio users.

The aim of administrative pricing is to encourage users to make more efficient use of the spectrum with the intention of bringing the demand for spectrum into equilibrium with its supply by encouraging users to install more spectrally efficient equipment, handing back spectrum they do not need or moving to a less congested part of the spectrum. Depending on the circumstances, such a measure may be revenue neutral. The Director intends to issue a consultation paper by Autumn 2002 on the implementation of Administrative Pricing.

Other Aspects of Licensing

Where it is necessary to limit the number of licences, competitions need to be held in compliance with EU and national legislation which is described in Part B below. The best way to support national development objectives is to use comparative selection processes designed to meet national needs. Where licence holders wish to sell their businesses, the ODTR operates a simple policy for licence transfer, concentrating on ensuring the full and effective take-over of the licence commitments by new owners, and the maintenance of competition. It is not possible for a mobile operator for example, to sell its business to another mobile operator (or connected party) operating in Ireland. Where some or all of spectrum assignments are not being used, they are retrieved from operators in accordance with licence terms and re-assigned. In order to encourage innovation and development, the ODTR operates a test licence regime, which manufacturers and operators and other competent parties may use to test and demonstrate the technical capabilities of new equipment for example. This is described more fully in Part A of this document.

Summary of all Spectrum Management Objectives:

For Public Cellular Services:

1. measure the Quality-of-Service offered by network operators to ensure that they are in compliance with their licence conditions;
2. utilise the available GSM and IMT-2000 spectrum to the maximum efficiency achievable within current technological capabilities;
3. protect and promote the interests of users of Irish mobile cellular services in national and international fora;
4. continue to develop co-ordination agreements with neighbouring countries for 3rd generation systems in the same vein as the GSM MoU[4];
5. monitor developments in evolution and coexistence of the IMT-2000 family of 3G standards;
6. actively participate in international fora on mobile system development.

For the Fixed Service:

1. in light of the importance of spectrum allocations for the Fixed Services it is the intention of the ODTR to review use of fixed service spectrum during 2002;
2. improve the use of the Fixed Service frequency allocations and assignments through a programme of compliance audits and investigations;
3. protect and promote Fixed Service end user interests in international fora;
4. complete the development of an electronic licensing regime which will permit online licence applications and fee payments.

For Short Range Devices:

1. permit the use of Short Range Devices (SRD) in bands allocated to low power applications wherever possible, having regard to the regulatory requirements for efficient spectrum usage;
2. monitor market interest in the development of SRD;
3. contribute to the work of the CEPT, in association with industry, in developing harmonised bands for low power applications.

For Broadcasting:

1. complete international co-ordination of the initial plan for Digital Terrestrial Television coverage in Ireland;

[4] MoU = Memorandum of Understanding

2. monitor the development of digital modulation techniques that have the potential to replace the analogue broadcasting services with high quality services in the short-wave, medium-wave and long-wave broadcast bands;
3. ensure operator compliance and protect authorised services from illegal spectrum use;
4. prepare for the proposed T-DAB planning meeting in 2002;
5. prepare for the Stockholm 1961 TV frequency re-planning exercise, scheduled for 2004.

For Business Radio:

1. improve the use of the land mobile spectrum through a programme of spectrum monitoring, investigations and targeted audits leading to improved band usage and better quality of service on individual assignments;
2. investigate possibilities of and encourage the introduction and use of spectrally efficient technologies;
3. continue commitment to providing a diverse range of services in the land mobile radio bands;
4. develop methodologies for the identification of congestion on PMR channels including the use of monitoring data;
5. ensure that frequency requirements for current and future Public Access Mobile Radio Network operators are met;
6. protect the interests of Irish PMR users in international fora and bilateral discussions.

*For Satellite Services***:**

1. protect national Fixed-Satellite Service (FSS) and Broadcasting-Satellite Service (BSS) end-user interests in international fora;
2. facilitate electronic licensing through the CEPT One-Stop-Shopping initiative;
3. develop a suitable regulatory regime for emerging new Satellite Services.

For the Aviation Sector:

1. continue to provide protection for those aeronautical services which are considered as safety services;
2. continue close co-operation with the Irish Aviation Authority;
3. continue to provide spectrum for use by new emerging Aeronautical systems.

For the Marine Sector:

1. continue to provide protection for those maritime services which are considered as safety services;

2. continue to promote the use of spectrum efficient technologies, thereby maximising the spectrum available for Maritime use;
3. continue to provide spectrum for use by new emerging Maritime systems;
4. transfer the function of ships radio licensing to the Department of the Marine.

For the Science Services:

1. liaise with Met Éireann and other scientific organisations to ensure that current and future spectrum requirements of the Science Services are fully understood and, wherever possible, incorporated into national plans for future spectrum planning conferences;
2. remain appraised of possible means of reducing unwanted emissions to protect Radioastronomy and other passive services;
3. protect national Science Service interests in national and international fora.

For the Meteorological Service:

1. the ODTR will continue to offer a high degree of protection to meteorological services, in view of their use in the safeguarding of human life and property;
2. the ODTR will continue to offer a high degree of protection to Earth Exploration services in view of the potential impact of interference on passive and active sensors which can severely disrupt scientific research programmes.

For Experimenters:

1. where not required for other services the ODTR will endeavour to support, where possible, the requirements of the amateur radio sector.

For the Frequency, Time and Radiodetermination Services:

1. the ODTR will continue to offer a high degree of protection to time and frequency services, in view of their use in the safeguarding of human life and property;
2. protect national radiodetermination service interests in national and international fora;
3. remain appraised of possible means of reducing unwanted emissions to protect the radiodetermination services.

Part A:

5. DEVELOPMENT OF A STRATEGIC FRAMEWORK FOR RADIO SPECTRUM MANAGEMENT

5.1. ECONOMIC IMPACT OF RADIO SPECTRUM USE

Use of the radio spectrum contributes to the development of Ireland's economy and society. The best known use is for mobile telephony, now used by four out of five Irish people and accounting for some €1.2 billion turnover per annum. Given Ireland's infrastructure deficit and scattered population outside of Dublin it is essential that radiocommunication is fostered and facilitated so that it makes the most effective contribution possible to reducing the deficit and bridging the digital divide.

Radiocommunication is a fundamental element of the telecommunications and broadcasting industries, as well as being crucial to the control and safety of transport systems, operations of a modern defence capability, the provision of emergency services and a wide range of social, scientific research and cultural activities.

Efficient management of the radio spectrum contributes to economic growth by:

1. supporting the development of existing and new innovative services in a timely manner;
2. supporting the development of knowledge-based services and attracting foreign investment;
3. attracting foreign investment;
4. promoting competition in communications services (e.g. FWA can provide competition in the local loop, mobile services compete with fixed telecoms);
5. promoting the competitive provision of radio-based equipment.

In some key frequency bands there is considerable demand for spectrum, particularly in densely populated areas where demand can exceed supply. Certain bands are more attractive to use than others, which decreases spectrum availability in those bands. For example, mobile communications are accommodated in spectrum bands which are also well suited to use by other services such as aeronautical, maritime, scientific and military applications. Because of this spectrum managers face a complex task when seeking to accommodate the various types of services in constrained frequency bands.

5.1.1 Key Market Indicators

According to a recent European Commission report[5], Europe's telecommunications sector is still growing strongly, despite the global economic downturn, and continues to represent a substantial growth factor in the European economy. The combined national markets of the fifteen Member States will expand to an estimated €218 billion in terms of revenue by end 2001, representing growth of 9.5% compared to 2000.
The radiocommunication industry makes a substantial contribution to Ireland's GDP as well as the more intangible benefits we all enjoy from the use of radio, ranging from the enjoyment of a favourite TV programme to the convenience of mobile phone use and the safety of air transport services.

As of December 2001, the key telecommunications market indicators[6] include:

1. total revenues for fixed, mobile and broadcasting markets at the end of December 2001 stands at an estimated €3.26 billion per annum on an annualised basis, an increase of approximately 3% since the last quarter. This figure has increased by approximately 14% since December 2000;
2. the telecoms sector is now estimated to account for approximately 3.17% of Irish GDP (2001)[7] an increase of 0.07% since the last quarter;
3. the Irish mobile penetration rate is now 79%, an increase of 12% since this period last year;
4. the total number of employees in the telecoms sector is approximately 16,700. The fixed, mobile and cable markets account for approximately 78%, 16% and 6% of the total figure respectively. There has been a decline of approximately 2% since last quarter.

[5] Source: Commission of the European Communities – Communication from the Commission to the Council, The European Parliament, The Economic and Social Committee and the Committee of the Regions. Seventh Report on the implementation of the telecommunications regulatory package COM(2001) 706, 28 November 2001.
[6] The Irish Communication Market Quarterly Review (ODTR 02/26), March 2002.
[7] Figure was calculated using GDP at market price (2000) – ESRI Quarterly Economic Commentary, Dec 2001

5.2 MARKET DEVELOPMENT AND THE NEED FOR RADIO SPECTRUM MANAGEMENT

After a period of explosive growth of fixed and mobile telecom markets in the 1990s, there has been much slower growth over the last year in part because of the world-wide economic slowdown. This is evidenced both by the fall in the value of telecom stocks and sharply reduced levels of investment in telecommunications internationally since 2000. Market uncertainty has meant that new services, such as 3G mobile and broadband access (wired and wireless), are not being rolled out as quickly as anticipated.

A similar situation exists in the Irish communications sector. However, the economy is still growing at a faster pace than the average European countries and therefore creation of new jobs is partially offsetting this trend. Despite the market slowdown, the general trend towards convergence and providing consumers with increased mobility and ubiquity of services continues. Digitalisation and Internet standards are driving progress toward convergence of the underlying technology for delivering information, communication and entertainment services. At the same time, there is increasing competition between delivery platforms.

The main new wireless services that have been initiated include:

1. digital TV and radio services which can be delivered terrestrially and by satellite;
2. mobile digital TV services will be possible. (For example in Singapore a DTT service is currently operating, delivering services to local buses);
3. 2.5 G services are already available in Ireland (GPRS and HSCSD) and the first 3G services are already available in Japan, Isle of Man and Monaco offering a wide range of data and real-time video services;
4. converged phone and broadcast services. For example integration of a DTT or DAB receiver with a 3G mobile handset permitting digital TV or sound broadcast reception on a mobile phone;
5. broadband wireless access to fixed telecommunications networks;
6. wireless local area networks provided in homes, offices and public spaces (e.g. airports, hotels) doing away with the need for internal cabling and a fixed connection to the network;
7. many short range / untethered devices providing wireless connectivity between devices (such as PCs, personal digital assistants, mobile phones, game machines etc), supporting electronic financial transactions (e.g. between a phone and vending

machines) and communications between appliances and the owner or third parties (e.g. for communicating status information about the appliance).

These services will compete with – or sometimes complement - fixed line broadband options such as ADSL and its successors, cable modems and optical fibre.

Convergence raises the fundamental question of whether current service definitions used by spectrum managers will make any sense by the end of the decade when many voice services may be delivered using Internet Protocol (IP). Convergence will also require changes to existing licensing regulation in order to allow technology-neutral licence regimes for new services. This is reflected in the new EU Directives that were adopted in early 2002. Uncertainty about the speed of deployment of new technologies and services, and their adoption by businesses and consumers makes it unclear how much and when additional spectrum will be required for new services. To address this problem, spectrum managers may need to make provision for new services in a more flexible manner than has been the case up to now.

5.3 DEVELOPMENTS IN KEY SERVICES

5.3.1 Broadcasting

The broadcasting service is a major user of the radio frequency spectrum. Due to the importance attached to it from a political, social and cultural perspective it has been, and no doubt will continue to be, afforded a prominent position in both international and national spectrum allocation policies.

Digital broadcasting is currently a major technological change in the broadcasting area. However as it is not backward compatible with the existing analogue systems, a "simulcasting" approach is being adopted to reduce disruption to the consumer. Where there is presently a large established user base and a lengthy product replacement cycle, the time required for transition from one technology to the next can be considerable. In relation to Digital TV it can be expected that the digital technology currently being introduced will form the basis of digital television transmission for a considerable time.

Digital Audio Broadcasting (DAB) is heralded as the next significant development for sound broadcasting although in Europe the take up has to date been limited. As DAB

multiplexes can carry typically 5 to 6 programme services, the multiplex could also be used to deliver additional data type services.

Digital Terrestrial Television (DTT) is the next significant development in television broadcasting. Each DTT multiplex can carry a number of programme services although the typical figure is four. A DTT multiplex can also be used to deliver additional data type services. Currently Ireland is planning for 6 DTT multiplexes using the UHF broadcast bands (Bands IV & V). Work is also progressing toward a regional planning conference to re-plan the broadcast bands III, IV and V. The plan that is agreed at the conference will form the basis for VHF/UHF broadcasting for possibly the next 20 to 30 years.

In Ireland Multipoint Microwave Television Distribution Systems (MMDS) have been deployed using the 2500 to 2680 MHz band. From 1 January 2005 the allocation of the bands 2500-2520 MHz and 2670-2690 MHz to the mobile-satellite service (space-to-Earth) on an international basis becomes effective. These bands may be used by administrations wishing to implement the satellite component of IMT-2000. This may have an impact on MMDS services in these bands and the current MMDS licence conditions reflect this potential issue.

The complete band from 2500 MHz to 2690 MHz has been designated by the ITU for use by IMT-2000 (3G) services and has been identified by CEPT as the primary band for expansion of 3rd generation mobile communications services in Europe. The long term impact of these future services on MMDS in Ireland is being carefully evaluated. A review is planned for 2004 to determine the long term use of the band.

Multimedia Wireless Systems (MWS) at 40 GHz are being developed to provide broadband wireless communications that will meet future consumer requirements for bi-directional multimedia applications. Prototype system concepts which emphasise a high degree of spectrum reuse and bandwidth on-demand are being developed and tested. The ODTR has added this frequency band for MWS use in the national table of frequency allocations in line with the European Common Allocations, but in the response to a recent consultation paper there appeared to be little demand at the moment for MWS at 40 GHz.

5.3.2 Fixed Services

In providing transmission capacity, radio instead of cable is often the preferred solution where constraints such as cost, local topography (e.g. mountainous terrain, paths across water) and the need for access to remote rural regions are fundamental considerations. In urban areas the use of cables can be more cost effective due to the larger capacity they can provide. However fixed radio systems also have a role to play as they provide the operator with the ability to roll-out a network rapidly and the capability to install transmission paths as and when required. In addition delays arising from obtaining way-leave rights can be minimised.

This growing demand for access to the radio spectrum resource is likely to place increasing pressure on all frequency bands. While the mobile services are placing considerable pressure on fixed service frequency bands below 3 GHz, the demand by the fixed service will mainly be on bands above 3 GHz, where line of sight is generally required between stations. Requirements for fixed and mobile radio links is expected from the Public Telephone Networks, GSM networks, 3rd generation mobile networks, FWA networks and in the future from Multimedia Wireless Systems (MWS). It is anticipated that the support infrastructure for these networks will necessitate very high usage of fixed radio links.

Due to the smaller cell size likely to be employed for 3rd generation mobile networks, the number of radio links required could be significantly higher than current 2nd generation networks, especially where suitable cable infrastructure does not exist. However most of these links are likely to be very short (less than 10Km) enabling less congested higher frequency bands (above 30 GHz) to be used. A different approach to the licensing of links in these higher bands than currently used may have to be considered. In light of the importance of spectrum allocations for the Fixed Services it is the intention of the ODTR to review use of fixed service spectrum during 2002.

5.3.3 Fixed Wireless Access (FWA)

The ODTR is currently conducting a consultation[8] on FWA with a view to licensing further FWA spectrum.

The document invites comments on a number of specific proposals that have been developed in the light of a FWA review conducted and are intended to stimulate the provision of FWA and related services in Ireland. These proposals relate to:

1. rationalisation of spectrum assignments in the 26 GHz band to reflect the potential range of services that might be offered over FWA networks;
2. licensing of local area FWA networks in the 10.5 GHz band; and
3. use of licence exempt spectrum in the 5.725 – 5.875 GHz band to provide public access to data networks.

5.3.4 Short Range Devices

The term "Short Range Device" (SRD) is intended to cover the radio transmitters which provide either uni-directional or bi-directional communication over short distances and which have a low probability of causing interference to other radio spectrum users. A wide range of spectrum use has been made exempt from individual licensing, typically because the power and propagation characteristics of these services is so localised that they do not materially interfere with other spectrum users. With advances in radio technology, there is growing commercial interest in developing products that utilise spectrum set aside for short range devices, for example, home /office local area wireless networks and wireless connectivity technology such as 'Bluetooth'.

Some of the SRD services developed can be partial substitutes for and/or complements to licensed spectrum applications, such as mobile phones. The absence of spectrum usage charges may encourage commercial operators to focus their research efforts on using this spectrum. Equally, the lack of protection from interference offered to users of such spectrum may militate against operators providing a commercial service, since they may face difficulties in guaranteeing the quality of transmissions.

Recently the ODTR published a Briefing Note on wireless local area networks[9], (WLANs) and a consultation paper on fixed wireless access[10], part of which considers the use of the 5.8GHz band for WLANs. The main application of WLANs is in the provision of broadband data transfer within buildings, including offices, hotels, shops and homes. For example, WLANs enable laptop computers to be connected to communications networks, without being constrained by cables and fixed access points.

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[8] Document ODTR 02/19 – Expanding opportunities in the Radiocommunications Market: FWA.
[9] Source: ODTR Document No. 02/16
[10] Source: ODTR Document No. 02/19

It is envisaged that new high speed applications (e.g. for people who need to work while travelling) will develop that harness the broadband access afforded by WLAN technology. WLAN technology is also used externally, extending the reach of local area networks. This application is useful for interconnecting LANs in different buildings (e.g. on a university campus) and as a way of possibly providing broadband Internet access to residential users. There has been a lot of interest in the use of WLANs and further comment is made in Part C of this document on this issue.

5.3.5 Third Generation Services (3G) Mobile Cellular Services

3G mobile represents the latest development in the evolution of mobile communications, combining high bandwidth multimedia performance with wide area mobility. The development is underpinned by global initiatives to set aside dedicated radio spectrum and to develop harmonised equipment standards. The ODTR is currently running a competition to offer four 3G mobile licences.

In order to encourage market entry at both the service and infrastructure levels, two distinct 3G licence packages will be offered. The "class A" licence will include as an evaluation criterion the offering of a voluntary commitment with regard to the access price for MVNOs[11] and where such a commitment is made, additional spectrum comprising up to 2 x 5.2 MHz of spectrum in the 900 MHz band and 5 MHz of unpaired 3G mobile spectrum will be made available to the successful applicant, subject to demonstrable need.

Additional spectrum will also be made available, subject to compliance with a pre-defined spectrum efficiency threshold, to successful applicants who do not already have access to 2G spectrum or who are not connected to undertakings[12] which have such access. In the case of a single new market entrant, this spectrum will comprise up to 2 x 7.2 MHz of spectrum in the 900 MHz band, and up to 2 x 6.0 MHz in the 1800 MHz band. In the case of more than one new market entrant, spectrum in the 900 MHz and 1800 MHz bands will be made available as necessary to cater for individual operators demonstrable needs.

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[11] For the purposes of this response document, an MVNO is defined as an organisation operating a physical network infrastructure comprising as a minimum a mobile switching centre, home location register and authentication centre (or 3G mobile equivalents), having its own unique mobile network code with distinct IMSI and E.164 number series (where applicable), and issuing its own branded SIM cards (or 3G mobile equivalent), but without a mobile radio access network. This definition is consistent with the Director's objective to promote competition at both the service and infrastructure level.

[12] A connected undertaking is any entity that has a shareholding link with any existing licensed GSM networks in Ireland.

5.3.6 Business Radio

Despite the rapid growth of cellular telephony, Business Radio is still the preferred communication system for applications where most traffic is between a control point and one or more mobile terminals, or where groups of mobile terminals need to communicate on a "one to all" basis. The main uses of Business radio are for public safety and security (e.g. the Garda Síochána, fire and ambulance emergency services), public utilities (power, water, transport etc.), industrial and commercial users as well as various voluntary organisations, all of whom need reliable means of communicating with personnel and more especially groups of personnel on the move. There are two principal types of Business Radio, namely Private Mobile Radio (PMR) and Public Access Mobile Radio (PAMR). PMR systems are operated by the organisation or individual holding the licence, for their own exclusive use, whereas PAMR systems provide service on a commercial basis to third parties who do not require a licence. In Ireland, the term PAMR includes community repeater operators.

Recent years have seen a number of developments that have enhanced the reliability and security of PMR and PAMR systems. For the most demanding user (security and emergency services) features such as specialised data encryption & transmission and inter-working are important. The advent of new European digital standards such as TETRA (Terrestrial Trunked Radio) and Digital Interchange and Information System (DIIS or Discus) are expected to bring further benefits to Business Radio users, such as the ability to combine voice and data services and to transmit data at higher speeds. TETRA is particularly attractive for larger systems such as those run by the emergency services, whereas Discus is intended to provide enhanced functionality for smaller PMR users.

5.3.7 Satellite Communications

The fixed satellite service (FSS) forms an important part of telecommunications networks. While initially it was used extensively for intercontinental/international applications, in more recent years some countries have deployed satellite systems for domestic purposes. With the development of fibre optic cables, with their inherently high capacity, the use of satellite communications for intercontinental applications has reduced. However, as with other satellite services, the FSS is well suited to delivering

communications over a wide area, be it country or region-wide. The fixed satellite service will continue to play an important role in the future delivery of broadband telecommunications services including direct-to-home (DTH) delivery. This type of application results in a proliferation of small earth stations/consumer terminals.

The mobile satellite service (MSS) includes Land mobile, Maritime mobile and Aeronautical mobile satellite services as well as generic services such as *Globalstar*. Maritime and aeronautical satellite services, in addition to normal communications, also provide important safety functions such as the Global Maritime Distress and Safety Service (GMDSS). The mobile satellite service provides a variety of voice, data, fax and messaging services throughout the world that complement the terrestrial cellular networks. The satellite component of 3rd generation mobile is expected to comprise of constellations of non-geostationary satellites using spectrum between 1 and 3 GHz.

Broadcasting by satellite comprises both individual reception of TV or radio programmes, often called direct-to-home (DTH) or direct broadcasting by satellite (DBS), and community reception for subsequent distribution by cable or terrestrial radio (MMDS). Individual reception involves simple receiving installations with small antennae, requiring a strong signal from the satellite and very effective protection against interference. In general, satellite services share frequency bands on an equal (i.e., co-primary allocation) basis with terrestrial services such as the fixed or mobile service. By its nature it is not easy to share the same frequencies between satellite communications, e.g., typically one or more satellites serving a number of earth stations within a region or country, and terrestrial services and special procedures have been developed in the ITU Radio Regulations for coordination between these respective systems. For example, VSATs which use relatively small antennae with low gain and poor side-lobe discrimination, receiving signals from a satellite can be easily interfered with by high power point-to-point links operating on the same or adjacent frequencies. Similarly, transmitting earth stations can interfere with terrestrial services over a significant geographical area. Successful sharing usually requires one or more of the following techniques to be adopted, namely: separation in terms of frequency, or geographical separation between satellite earth stations and stations of the fixed service, or interference mitigation techniques such as transmitter power control, dynamic frequency selection, constraints on power levels, etc. However, these can be economically expensive and technically demanding so they are not lightly undertaken.

5.3.8 Recent Developments in Radiocommunications Technology and Applications

A prominent feature of the telecommunications sector is the extent to which it is subject to rapid technological innovation and changing market conditions. The ODTR has a Forward-looking Programme dedicated to identifying new technologies and to examine their application and implications for Ireland. The ODTR has published briefing notes[13] on Ultrawideband Communications, High Altitude Platform Stations, Broadband VSAT (Very Small Aperture Terminals), Optical Wireless, Wireless LANS, Software Defined Radio and Next Generation Networks[14]. More detail on these can be found in part C of this document.

Details on other services such as the Aviation, Maritime, Military, Amateur, Science and Radiodetermination services can also be found in Part C of this document.

5.4 BROAD SPECTRUM MANAGEMENT OBJECTIVES

For almost a century, radio has made a vital contribution to Ireland's society and economy. From its early years as a specialist tool providing essential communications for the maritime, aeronautical, transport and public safety it has evolved to mass-market medium providing users with information, communications and entertainment. Over the last decade mobile communication, which depends entirely on the use of the radio spectrum, has become one of the world's fastest growing industries. Seventy-nine percent of the Irish population now owns a mobile telephone. The latest developments in technology and applications including fixed wireless access, third generation (3G) mobile communications and short range wireless connectivity devices herald a new era of competitive, broadband communication services for Irish businesses and consumers, while digital broadcasting is set to deliver a multitude of new channels and novel, interactive services.

It is clear therefore that radio has a key role to play in shaping the future delivery of electronic communications in Ireland. However, the radio spectrum itself is finite and due to the limits of technology only a small percentage of the spectrum can currently be used for communications purposes and like other limited natural resources must be managed carefully if the maximum benefit is to be obtained. Recognising the speed of technological change and growth in the use of the radio spectrum, it is important to

[13] See ODTR Document 01/59 – Technology developments in Telecommunications – Briefing note series.

review arrangements for managing the spectrum to ensure that they are well tuned to the needs of consumers and the industry.

Considering the economic impact of radio spectrum use and the need for Radio Spectrum Management, the overall objective of this initiative is to develop a Spectrum Strategy Framework which will establish guiding principles for managing the radio spectrum resource in Ireland's interest.

There follows a detailed listing of objectives which will be helpful to spectrum managers and users alike. It should be noted that they are compatible with the objectives underlying the new Communications Regulation legislation (specifically sections 12 and 13) and the new EU telecomunications framework due to come into effect next year, as shown in the following extract from the Framework Directive:

TASKS OF NATIONAL REGULATORY AUTHORITIES
Article 8
Policy Objectives and Regulatory Principles

1. Member States shall ensure that in carrying out the regulatory tasks specified in this Directive and the Specific Directives, the national regulatory authorities take all reasonable measures which are aimed at achieving the objectives set out in paragraphs 2, 3 and 4. Such measures shall be proportionate to those objectives.

Member States shall ensure that in carrying out the regulatory tasks specified in this Directive and the Specific Directives, in particular those designed to ensure effective competition, national regulatory authorities take the utmost account of the desirability of making regulations technologically neutral.

National regulatory authorities may contribute within their competencies to ensuring the implementation of policies aimed at the promotion of cultural and linguistic diversity, as well as media pluralism.

2. The national regulatory authorities shall promote competition in the provision of electronic communications networks, electronic communications services and associated facilities and services by inter alia:

(a) ensuring that users, including disabled users, derive maximum benefit in terms of choice, price, and quality;
(b) ensuring that there is no distortion or restriction of competition in the electronic communications sector;
(c) encouraging efficient investment in infrastructure, and promoting innovation; and
(d) encouraging efficient use and ensuring the effective management of radio frequencies and numbering resources.

3. The national regulatory authorities shall contribute to the development of the internal market by inter alia:

[14] See ODTR Document 01/88 – Next Generation Networks – Briefing note series.

(a) removing remaining obstacles to the provision of electronic communications networks, associated facilities and services and electronic communications services at European level;
(b) encouraging the establishment and development of trans-European networks and the interoperability of pan European services; and end-to-end connectivity,
(c) ensuring that, in similar circumstances, there is no discrimination in the treatment of undertakings providing electronic communications networks and services;
(d) cooperating with each other and with the Commission in a transparent manner to ensure the development of consistent regulatory practice and the consistent application of this Directive and the Specific Directives.

4. The national regulatory authorities shall promote the interests of the citizens of the European Union by inter alia:

(a) ensuring all citizens have access to a universal service specified in Directive 2002/22/EC (Universal Service Directive);
b) ensuring a high level of protection for consumers in their dealings with suppliers, in particular by ensuring the availability of simple and inexpensive dispute resolution procedures carried out by a body that is independent of the parties involved;
(c) contributing to ensuring a high level of protection of personal data and privacy;
(d) promoting the provision of clear information, in particular requiring transparency of tariffs and conditions for using publicly available electronic communications services;
(e) addressing the needs of specific social groups, in particular disabled users; and
(f) ensuring that the integrity and security of public communications networks are maintained.

Within this framework the spectrum management objectives, which we believe are central to an effective Spectrum Strategy, are:

1. to promote and support the orderly development and efficient operation of radiocommunication systems and services to facilitate the rapid development of a competitive, leading edge telecommunications sector that provides the best in terms of price, choice and quality to the end user, attracts business investment and ensures ongoing social and economic growth;
2. to plan and manage the utilisation of the spectrum resource in accordance with both national and international legislation;
3. to facilitate the use of radio/wireless systems to reduce the national telecoms infrastructure deficit as identified inter alia in the National Development Plan;
4. to further optimise use of the spectrum resource by, for example, the adoption of advanced spectrum allocation and management techniques based on operational requirements, bearing in mind technical and economic viability;
5. to protect national interests when harmonising and co-ordinating spectrum utilisation with other countries and regional and international organisations;

6. to ensure flexibility and ease of access to radio spectrum in reaction to technological advances and market factors in order to leverage Ireland's competitive advantage in this area;
7. to support and promote innovation, research and development in new radiocommunication techniques, spectrum-based services and applications;
8. to co-ordinate and establish spectrum and radiocommunication policies and plans by widely consulting with all interested parties.

In addition a number of ***strategy guidelines*** have been adopted to align spectrum management strategy and philosophy. These are:

1. to plan and allocate the radio frequency spectrum, a finite resource, in order to advance the broad-spectrum management objectives adopted in this document;
2. to adapt the allocation of, and access to, the spectrum resource to provide spectrum that best meets the needs of the user and to facilitate new and innovative services;
3. to continue to place emphasis on efficient spectrum utilisation and conservation techniques as a requirement for existing and new services;
4. to encourage the use of spectrum efficient radio systems and the use of the most appropriate frequency band for the application in order to maximise spectrum usage in critical frequency bands;
5. to continue providing and protecting radio spectrum for public safety, emergency services and safety of life services in view of their vital role in the safeguarding of human life and property;
6. to review the current procedures with a view to bringing licence duration more in line with investment cycles, noting that a radio licence does not confer ownership nor a continued right to a particular radio frequency;
7. to endeavour to provide reasonable notice to inform users of any conditions or circumstances which could result in displacement of services or systems to other bands – however it should be recognised that this will not always be possible;
8. to continue authorising radiocommunication system trials and new technology experiments in frequency bands appropriate to the intended applications and subject to the availability of suitable spectrum;
9. to specify compliance with international agreements on frequency usage and technical standards as a requirement for spectrum access, recognising that these agreements are necessary for harmonious system operation, efficient spectrum management, spectrum utilisation, compatibility, competitiveness and avoidance of interference;

10. to consider the arrangements for the introduction of Administrative Pricing in order to encourage efficient use of the spectrum, with the intention of bringing the demand for spectrum into equilibrium with its supply. It should be noted that Administrative Pricing can be revenue neutral. Regulations for this purpose will be subject to the consent of the Minister for Public Enterprise;
11. to continue operating its consultation procedures in order to have the benefit of user and industry views when making decisions.

5.5 ASSIGNMENT OF SPECTRUM

Firstly, in line with national objectives in respect of national and in particular infrastructure development, access to spectrum should be as easy, quick and inexpensive as possible. Starting in the summer of 1997, when guidelines for applications for radio links were issued, the ODTR has developed and placed on its web-site guidelines and standard application processes for all radio frequency applications. In 1998 the ODTR started work on a major programme of computerising and streamlining frequency assignments and licensing. Work is on-going in relation to the development of electronic licensing, however, this is unlikely to be available prior to the implementation of the EU Directives. Currently technical details for radio link applications may be submitted electronically to the ODTR and payments may be made by credit card and direct debit. In addition, technical calculations and interference analysis for fixed link assignments are automated.

As a result of this on-going process of computerisation the processing periods for all radio frequency applications have been reduced. For example, the processing period for applications for radio link licences has reduced from typically 3 months or more in 1998 to one week in 2002. . There are some 16,000 active radio frequency licences of which 11,200 are Business Radio licences, 4,400 are point-to-point and point to multi-point radio links and there are a further 400 miscellaneous licences including satellite Earth-stations and community repeaters.

Spectrum is generally assigned using one of the following techniques:

1. where systems can operate without unduly affecting other users (for example, short range devices) then access to frequencies should be on a licence exempt basis;

2. where specific assignment of spectrum is necessary and there is substantial availability of spectrum, it is generally assigned on a first come first served basis;

3. where demand exceeds supply the use of comparative selection procedures may be employed to assign the spectrum to specific users;

4. with increased demand in some bands the use of techniques such as administrative pricing is being considered.

5.6 ADMINISTRATIVE PRICING OF SPECTRUM

The radio spectrum is a finite but reusable resource, some parts of which cannot be fully utilised due to limitations in current technology. Use is further constrained by propagation effects and the requirement of some services for specific frequencies. If the spectrum is to be used efficiently and effectively it is essential that it is effectively managed at both the national and international level for the overall benefit of the country, to avoid unwanted interference and ensure equitable access to the spectrum for existing and potential users. To achieve this aim it is necessary to control access to the spectrum and this can be achieved by issuing licences to radio users. The manner in which licences are issued can vary considerably and methods such as 'first-come-first-served', 'beauty contests' or comparative selection processes and auctions have been used internationally for different services with varying degrees of success.

Licensing however, is only one aspect of managing the spectrum and it cannot function effectively without the support of other spectrum management activities, for example monitoring and enforcement. Many spectrum management functions are inter-related and each needs to be performed to provide an overall management package for the radio spectrum.

In Ireland, the ODTR is funded by licence fees and a levy on telecommunication turnover. Licence fees are charged for telecommunications, broadcasting transmission and other radio spectrum uses, including mobile telephony and radio links. As indicated in the consultation paper on Authorisations, the question of the fee structure will be reviewed later this year in light of the new EU directives.

However, apart from this general issue, there is a need to develop administrative pricing for parts of the spectrum where there is congestion. The purpose of this is to ensure efficient use of the spectrum and, depending on the circumstances, such a measure may be revenue neutral.

While congestion is not a serious problem in most geographical areas in Ireland, there are some key locations where it does occur and in such circumstances a number of options are open to spectrum managers, including:

1. ensuring that spectrum-efficient technology is utilised;
2. closing the affected bands or locations to prohibit further congestion;
3. allocating additional spectrum to the affected services in other bands;
4. migrating some users to other bands;

Administrative pricing can be used as a tool in facilitating such options (e.g. by encouraging spectrum users to use more spectrum efficient technologies).

Where Administrative Pricing looks to the market value of spectrum usage, defining the methodology to determine that market value becomes increasingly complex as the variables that must be taken into account increase. Depending on the service, the following variables in different combinations might be considered:

1. amount of bandwidth per channel used;
2. number of channels used;
3. loading on the channel;
4. local, regional or national application;
5. congested or uncongested areas;
6. area covered;
7. quality of service required;
8. is a new innovative system being implemented?
9. has the user relocated?

Administrative pricing is increasingly being considered as a spectrum management tool by administrations in Europe and elsewhere. It has been adopted in the UK, France and Spain, is being considered in Finland and Portugal and is applied in Australia and New Zealand. The Director intends to issue a consultation paper by autumn 2002 on the implementation of Administrative Pricing.

5.7 OTHER ASPECTS OF LICENSING

Where it is necessary to limit the number of licences, competitions need to be held. The best way to support national development objectives is by using comparative selection processes designed to meet national needs. The issues involved were discussed in particular in the consultation on 3G licensing[15]. Where licence holders wish to sell their businesses, the ODTR operates a simple policy for licence transfer, concentrating on ensuring the full and effective take-over of the licence commitments by new owners, and the maintenance of competition. Potential new owners must formally commit to meeting the obligations in the licence and to providing the necessary resources to enable this to happen. Competitions for spectrum routinely provide that operators may not sell on their businesses to others who are in the same business or are connected to them. Where some or all of spectrum assignments are not being used, they are retrieved from operators in accordance with licence terms and re-assigned.

In order to encourage innovation and development, the ODTR operates a test licence regime, which manufacturers, operators and other competent parties may use to test and demonstrate the technical capabilities of equipment. Radio test licences [16] can be issued for the carrying out of tests or trials on radio equipment, spectrum or services. Specifically, the test licence may not be used for the testing or development of markets and a test licence is issued on the understanding that the test is carried out on a non-commercial basis. Test licences are usually issued for relatively short periods, typically less than 6 months duration. The majority of test licence applications are for in-house testing.

5.8 CONVERGENCE AND SPECTRUM MANAGEMENT

Markets and technology are changing at an exceptional rate. As the use of digital technology becomes more widespread, differences between services are being eroded, at least from the consumer's point of view. In a digital network, broadcasting, voice transmission, data transmission, audio, video or any other type of communication are handled as a stream of digits and can all be transmitted and manipulated by similar technology. The result, known as convergence is that content is increasingly independent

[15] ODTR Document 00/52: Extending Choice – Opening the Market for Third Generation Mobile Services (3G Mobile) – Consultation Paper; and ODTR Document 00/92: Extending Choice – Opening the Market for Third Generation Mobile Services (3G Mobile) – Response to the Consultation.

[16] For more information on test licences see ODTR Document 99/15R: Licences for Radiocommunications Tests.

of the delivery platform. Technological convergence has been defined in various ways including:

1. the ability of different network platforms to carry similar kinds of services;
2. the merging of computing, telecommunications and broadcasting;
3. the merging of fixed and mobile services and
4. the ability of all networks to deliver all services.

There is considerable uncertainty in the current investment climate about the pace and direction of many developments. Given technological and market uncertainties, the ODTR continues to deal with the challenges raised by convergence by endeavouring to facilitate a competitive, leading edge radiocommunications sector.

However it is defined, convergence can be expected to have profound implications for society in general, on demand for radio spectrum and for the regulation of the converging sectors generally. It affects the ODTR in particular as the telecommunications regulator is responsible for managing the radio spectrum in Ireland.

Part B:

6. THE RADIO SPECTRUM MANAGEMENT FRAMEWORK

6.1 THE GLOBAL FRAMEWORK LEVEL

The effective integration of each nation into the international community of spectrum users is required to ensure availability of interference free-services such as international air and maritime travel, satellite communications, international broadcasting and public safety services such as search and rescue. Because radio waves do not respect international boundaries and many systems operate on a world-wide basis, the international community has developed a structure for co-operatively managing interference between services and between nations. International co-operation in the field of telecommunications can be traced back to 1865 with the establishment of the International Telegraph Union. In 1939, participating nations decided to create a single organisation known as the International Telecommunications Union (ITU), governed by a single International Telecommunications Convention supplemented by the Radio Regulations.

The ITU uses a number of structures and associated meetings to carry out its activities, including World Radiocommunication Conferences that review and amend the Radio Regulations which contain technical and procedural provisions related to each of the various radio services. The Radio Regulations serve as the primary international agreement covering rules and procedures for operating radio equipment and resolving and preventing interference and contain the international frequency allocation table. While each nation remains sovereign in their use of the radio spectrum the work of the ITU forms the global framework on which regional and national planning is developed.

Ireland is increasingly operating in a global economy. International markets and competition must therefore be taken into account in the development and introduction of new services. Spectrum allocation issues will also have to take international impacts into account. There is an ongoing need for participation in international fora, with stronger emphasis on international opportunities,

competitiveness, harmonisation of standards and new market opportunities. Bearing in mind constraints to success which include differing spectrum allocations, timing of service introductions, standards, trade barriers and cultural differences, the ODTR's strategy on the international level is to:

1. support appropriate harmonisation of spectrum allocation world-wide;
2. ensure that Irish interests as a whole are promoted and at least not damaged where compromises have to be made;
3. continue to participate actively in key ITU activities in so far as available resources permit to support greater efficiency in its operations;
4. support the development of relevant international standards.

6.2 THE EUROPEAN FRAMEWORK LEVEL

6.2.1 The European Union

The European Union comprises 15 member States operating together under a series of international treaties. The Treaty on European Union[17] established the European Commission that is responsible for implementing the treaties, managing EU policy and making proposals for all new legislation. The EU Council comprises representatives of all Member States' governments and decides, with the European Parliament, on proposals presented by the Commission.

In preparing new legislation the Commission fulfils three main functions:

1. because of its right of initiative, the Commission is charged with making proposals for all new legislation. It acts on the basis of what it considers best for the Union and its citizens in general rather than on behalf of sectoral interests or individual countries. Its range of activities are laid down in the EC Treaty and range from trade, competition, industry and social policies to agriculture, the environment, energy, regional development and development co-operation;
2. before it issues an item of draft legislation, the Commission carries out extensive preliminary soundings and discussions with representatives of governments, industry, the trade unions, special interest groups and, where

[17] European Union Consolidated Treaties, Treaty on European Union, Treaty establishing the European Community - ISBN 92-828-1640-0

necessary, technical experts. As enshrined in the Treaty on European Union, the Commission takes the principle of subsidiarity into account in its proposals, initiating legislation only in areas where the European Union is better placed than individual Member States to take effective action;

3. once a Commission proposal has been submitted to the Council of Ministers and the European Parliament, the three institutions work together to produce new legislation.

The European Commission has its own set of policy objectives for radio spectrum usage which include:

1. facilitating technological innovation and competition in radiocommunications, mobile telephony and wireless local networks;
2. pursuing Community objectives with regard to the radio spectrum within a predictable and legally certain regulatory framework;
3. ensuring an appropriate balancing of the interests of the individual Member States, of the European Community and of the different user communities; and
4. safeguarding the Community's interests in the international negotiations on the radio spectrum.

These are accomplished through the use of Directives[18] issued by the EU. Of particular relevance to radio spectrum management are the Licensing Directive and other 'new approach' Directives such as the R&TTE (Radio and Telecommunications Terminal Equipment) and EMC (Electromagnetic Compatibility) Directives. Following a review of the whole EU Framework for telecommunications, on 14 February 2002, the European Union adopted a series of new Directives designed to strengthen competition in the EU electronic communications market. The package is intended to simplify and clarify the existing regulatory framework, by reducing the number of specific legal measures.

The new framework includes:

[18] The two main types of EU legislation are regulations which are directly applicable in all member states and Directives, which set out a framework that each Member State must transpose in their national law, allowing for some national variation in terms of the detail.

1. the **Framework Directive** that sets the overall context and defines overall principles and approaches;
2. the **Authorisation Directive** which describes the mechanisms through which services and networks may be provided, including the conditions which may be applied to operators;
3. the **Access Directive** that describes how networks and service may be accessed and how interconnection between public network and service providers will be regulated;
4. the **Universal Service Directive** which considers how universal service will be protected and regulated and also addresses consumer rights;
5. the **Spectrum Decision** concerning spectrum management issues.

The Framework Directive, the Authorisation Directive and the Radio Spectrum Policy Decision have both direct and indirect implications for radio spectrum management in Ireland. While the radio spectrum Decision applies immediately, Ireland has 15 months (until July 2003) to transpose the Directives into national law. The new regulatory package is intended to be technologically neutral, treating all transmission networks in an equivalent manner.

The Directives have to be transposed into national law; a process that must be completed in sufficient time to allow all aspect of the regime, including administrative arrangements, to be fully implemented within fifteen months. The framework is not fully prescriptive and there are areas where choices exist for Member States and competent authorities in the manner in which the aims of the Directives are to be achieved. These discretionary areas enable the common rules to take account of conditions in individual Member States while implementing the broad community framework. The most significant change from an Irish point of view is that the authorisation of all activities in relation to electronic communications networks and services will be based on the new EU Directives. At present, telecommunications licensing is subject to the Postal and Telecommunications Act, 1983, amended to give effect to EU requirements for the sector, and so, in effect, is largely governed by EU law. In contrast, broadcasting transmission is based on the Broadcasting Acts and the Radio and Television Act. Broadcasting retransmission services are subject to regulations made under the Wireless Telegraphy Acts while other services are

also subject to regulations made under the Wireless Telegraphy Acts. As a result, while some licence conditions are common across the range of licences, different procedures and requirements apply to many of the services.

The new EU framework requires that all of these various services be subject to technology-neutral common rules defined in the Directives. In doing so, the issue of convergence is addressed by ending the distinction between regulation of networks and services based on the type of service carried on particular platforms and providing instead for the regulation of all networks and services on a common basis.

6.2.1.1 The Framework Directive

This Directive aims to establish the principles governing the National Regulatory Authorities (NRAs) and Member States. In particular, the Directive defines the duties of Member States and the National Regulatory Authorities with regard to the distribution and granting of access to radio spectrum, numbering resources and the granting of rights of way.

The Directive also groups together the provisions that are common to the specific Directives and which define:

1. the concept of Significant Market Power (SMP) and the market analysis procedure to be used by NRAs to impose specific obligations on certain undertakings;
2. the procedures to be adopted to ensure uniform implementation of the new regulatory framework, for resolution of disputes between undertakings and to resolve problems of market access in 3rd countries;

Article 9 of the Framework Directive[19] defines a number of obligations related to the management of radio frequencies for electronic communications services. In particular it requires national regulatory authorities (NRAs) to:

1. manage spectrum efficiently;
2. ensure that the allocation and assignment of radio spectrum is based on objective, transparent, non-discriminatory and proportionate criteria;

3. promote the harmonisation of radio frequency usage across the Community to ensure effective and efficient use of the spectrum in accordance with the Radio Spectrum Decision[20];
4. allows NRAs to permit the trading of frequency assignments, subject to certain safeguards.

6.2.1.2 The Authorisation Directive

Following the liberalisation of telecoms markets within the European Union, most Member States continue to require some form of licence or authorisation from companies wishing to offer telecommunications services or operate networks in their territory. Attention at an EU level has focused on developing a common framework for these licences and for the procedures according to which they are granted in order to facilitate the development of a single market in telecoms.

The EU framework envisages two approaches to licensing. Firstly, the use of general authorisations, (e.g. statutory provisions, class licences) and, secondly, the use of special licensing procedures, to be used only in prescribed cases, in particular competitions for spectrum use. The aim of the Authorisation Directive[21] is to implement an internal market in electronic communication networks and services through the harmonisation and simplification of authorisation rules and conditions in order to facilitate their provision throughout the Community.

The Authorisation Directive:

1. lays down a procedure for limiting the number of rights of use to be granted for radio frequencies within a framework preventing limitations on the number of licences granted for a particular type of service or network;
2. contains an exhaustive list of the types of conditions which may be attached to a general authorisation;
3. these conditions cover a very wide range, of which effective use of radio frequency and conditions to facilitate monitoring and enforcement by

[19] Framework Directive (2002/21/EC) OJ L 108 of 24.4.2002 p. 33
[20] Spectrum Decision (766/2002/EC) OJ L 108 of 24.4.2002 p. 1
[21] Authorisations Directive (2002/20/EC) OJ L 108 of 24.4.2002 p. 21

National Regulatory Authorities (NRAs) are among those relevant to radio spectrum users;

4. provides that fees for general authorisations should be limited to covering the costs of issuing, managing, controlling and enforcing the licence. Coverage of the administrative costs incurred is also the principle for individual licences, but where these licences give access to scarce resources (frequency or numbers), charges may be imposed which "reflect the need to ensure the optimal use of these resources". In this context, the EU framework neither requires nor rules out the use of administrative pricing (pricing which seeks to reflect the economic value of the spectrum) or auctioning as a means of allocating licences for radio spectrum;
5. establishes time limits within which authorisation procedures or licensing should be completed.

At present the ODTR issues licences for telecommunication services (fixed, mobile and fixed wireless), broadcasting transmission, television distribution (cable, MMDS, deflectors) and a variety of other services which use radio frequencies. The conditions associated with each type of service are standardised in so far as possible, but differ from service to service reflecting the differences in the underlying legislation and the difference in services and technology. Under the provisions of these EU Directives, all services, including some services and networks currently licensed outside of Ireland, would be subject to the same rules from June 2003. Where the use of most radio frequencies is involved, it will still be necessary for the ODTR to grant rights on an individual basis and spectrum will continue to be allocated for specific purposes, e.g. mobile or fixed links. However, the conditions would also be standardised as far as possible.

6.2.1.3 Decision on Radio Spectrum Policy for Europe[22]

The Decision on EU radio spectrum policy follows the public consultation on the 1998 Green Paper on Radio Spectrum Policy and builds upon co-operation with the Member States and the CEPT in the area of spectrum management. The aim of the Decision is to establish a policy and legal framework in the Community in order to ensure the coordination of policy approaches and,

where appropriate, harmonise conditions with regard to the availability and efficient use of the radio spectrum.

In order to meet this aim, the Decision establishes procedures in order to:

1. facilitate policy-making with regard to the strategic planning and harmonisation of the use of radio spectrum in the Community, taking into consideration *inter alia,* economic, safety, health, public policy, freedom of expression, cultural, scientific, social and technical aspects of Community policies as well as the various interests of radio spectrum user communities with the aim of optimising the use of spectrum and of avoiding harmful interference;
2. ensure the effective implementation of radio spectrum policy in the Community, and in particular establish a general methodology to ensure harmonised conditions for the availability and efficient use of radio spectrum;
3. ensure the co-ordinated and timely provision of information concerning the allocation, availability and use of radio spectrum in the Community;
4. ensure the effective co-ordination of Community interests in international negotiations where radio spectrum use affects Community policies.

Under the Spectrum Decision a Radio Spectrum Committee will be established, effectively replacing the Licensing Committee established by the current Licensing Directive. The ODTR takes an active role in the Licensing Committee meetings, alongside the Department of Public Enterprise, to look after national interests and will expect to continue that role in the Radio Spectrum Committee.

With the exception of radio spectrum availability for mobile and personal communications, in which areas Community legislation exists, the European Community mainly relies on the work undertaken in ITU/WRC and CEPT to achieve the harmonisation of radio spectrum necessary for the pan-European and global provision of services and equipment.

[22] Spectrum Decision (766/2002/EC) OJ L 108 of 24.4.2002 p. 1

6.2.2 CEPT

The Conference of European Postal and Telecommunications Administrations (CEPT) was established in 1959 by 19 countries, which expanded to 26 during its first ten years, and is a body of policy-makers and regulators currently encompassing 44 European countries covering almost the entire geographic area of Europe.

The essential aims of the CEPT are to strengthen relations between member Administrations, to promote their co-operation and to contribute to creating a dynamic market in the field of European posts and telecommunications.

Its functions include:

1. working out common views on the priorities and aims set in the field of posts and telecommunications;
2. examining, in a European context, public policy and regulatory issues regarding posts and telecommunications;
3. promoting the harmonisation of regulations;
4. establishing necessary contacts and co-operation with European organisations and bodies and other institutions dealing with postal and telecommunications matters;
5. providing a forum for the preparation of common positions for congresses and/or conferences of international postal and telecommunications organisations and bodies.

The CEPT, which deals exclusively with sovereign regulatory matters, has established two committees, one on postal matters and one dealing with radiocommunications and telecommunications issues: the ECC (Electronic Communications Committee). The committees handle harmonisation activities within their respective fields of responsibility, and adopt recommendations and decisions. Under the ECC there are a number of work groups and project teams that will develop and deal with radio spectrum issues for consideration by the ECC plenary meetings.

The predecessor to the ECC, the European Radiocommunications Committee, has played a significant role in harmonising spectrum use in Europe providing,

for example, a table of European frequency allocations which is in effect a long term strategic plan for spectrum use and harmonisation, and many Decisions, Recommendations and Reports aimed at efficient spectrum utilisation and harmonisation. This work will continue under the new ECC[23].

Within resource constraints, the ODTR is actively involved in the working groups and the Committee plenary sessions of the CEPT.

6.3 RADIO EQUIPMENT STANDARDISATION FRAMEWORK

CENELEC, CEN and ETSI are the three European standardisation bodies which prepare European standards in specific sectors of activity. Most standards are prepared at the request of industry or as work "mandated" by the European Commission in support of legislation. If these standards are prepared in the framework of the "New Approach" Directives, they are known as "harmonised standards". The products manufactured in accordance with these standards benefit from a presumption of conformity with the essential requirements of a given Directive. Although they are precisely defined, the functions of CENELEC, CEN and ETSI inevitably overlap in a number of fields, such as the machinery sector or the information and communications technology (ICT) sector which overlaps with information technology, electronic components and telecommunications networks. Co-ordination of standardisation work is therefore essential.

6.3.1 ETSI

ETSI (the European Telecommunications Standards Institute) is a non-profit making organisation whose mission is to produce the telecommunications standards that will be used for decades to come throughout Europe and beyond. ETSI brings together 789 members from 52 countries inside and outside Europe, and represents administrations, network operators, manufacturers, service providers, research bodies and users.

The aim of ETSI is to produce voluntary open standards for radio equipment and systems and to promote the world-wide standardisation process whenever

[23] Readers should be aware that due to the recent change in name and structure from the ERC to the ECC, references in this document to either body are interchangeable between the two.

possible. Its Work Programme is based on, and co-ordinated with, the activities of international standardisation bodies, mainly the ITU-T and the ITU-R. ETSI has links (mainly Memoranda of Understanding) with a range of other organisations and standardisation bodies, such as CEN, CENELEC, EBU, and ITU and participates globally in the Global Standards Collaboration (GSC) and Radio Standardisation (RAST). One recent development of significance has been the formation of the Third Generation Partnership Project (3GPP), a global alliance of standardisation bodies which is responsible for generating standards for 3G mobile (IMT 2000/UMTS). With the formation of the 3GPP, ETSI covers all aspects of cellular narrow-band and broad-band radio communication and is tackling the wider issues of fixed mobile convergence and internet related platforms.

In order to provide a forum for development of co-existence criteria of radio equipment and other systems, ETSI brought together EMC and radio spectrum within a single committee called TC-ERM (Technical Committee for EMC and Radio Spectrum Matters). TC-ERM is responsible for preparing many of the candidate harmonised standards now required under the R&TTE Directive.

6.3.2 CENELEC

CENELEC is the European Committee for Electrotechnical Standardisation. It was set up in 1973 as a non-profit-making organisation under Belgian Law and has been officially recognised as the European Standards Organisation by the European Commission in Directive 83/189/EEC. Its members have been working together in the interests of European harmonisation, developing alongside the European Union. CENELEC works with 35,000 technical experts from 19 European countries to publish standards for the European market.

6.3.3 CEN

CEN is the European Committee for Standardisation and its mission is to promote voluntary technical harmonisation in Europe in conjunction with world-wide bodies and its partners in Europe.

6.3.4 R&TTE Directive

The Radio Equipment and Telecommunications Terminal Equipment (R&TTE) Directive is a recent measure introduced by the EC into Europe for the marketing, connecting and putting into service of telecommunications terminal equipment. The R&TTE Directive was transposed into Irish law on 5th June 2001 by Statutory Instrument 240 of 2001. The Directive replaces the earlier type-approval systems for telecommunications terminal equipment, i.e., it replaces the Telecommunications Terminal Equipment Directive (98/13/EC) and the Common Technical Regulations adopted under that Directive, as well as the existing national type-approval regulations. R&TTE incorporates the requirements of the EMC and Low Voltage Directives (Directive 89/336/EEC and Directive 73/23/EEC respectively). The majority of radio or telecommunications terminal equipment that is placed on the market or put into service in Ireland must now comply with the "essential requirements"[24] and all other relevant provisions of the R&TTE Directive.

The aim of the R&TTE Directive is to provide a simple procedure for manufacturers to access the EU market. Manufacturers are given a choice of conformity assessment procedures to follow in order to prove compliance. In addition, except in the case of radio equipment where a harmonised standard[25] is not used, the involvement of third parties in the conformity assessment is not mandatory.

6.4 ODTR STRATEGY AT THE EUROPEAN FRAMEWORK LEVEL

As noted above, Ireland operates within a complex international framework. The radiocommunication industry is increasingly a global industry and many of the radio services e.g., broadcasting, mobile, satellite communications etc., by their nature traverse national boundaries. Therefore management of the radio spectrum at the national level must be cognisant of the international environment within which we operate.

[24] See SI 240 of 2001: European Communities (Radio Equipment and Telecommunications Terminal Equipment) Regulations, 2001.

[25] A harmonised standard means a technical specification adopted by a recognised standards body under a mandate from the Commission in conformity with the procedures laid down on Directive 98/13/EC for the purpose of establishing a European requirement, compliance of which is not compulsory.

The ODTR strategy at the European Framework Level is:

1. to work within European frameworks to ensure that the availability of spectrum, regulatory practices, technology and equipment are in line with the mission of the ODTR;
2. to implement, to the maximum extent possible, the CEPT/ECC Table of European Common Frequency Allocations (see CEPT ERC Report 25 and ODTR Document 01/23);
3. where appropriate, to commit Ireland to implementation of ECC Decisions;
4. to influence and support the development of ETSI standards;
5. to improve co-ordination of frequency assignments with other administrations, through a harmonised European or global approach or by bi-lateral or multi-lateral agreements, as appropriate.

6.5 ODTR INTERNATIONAL STRATEGY GROUP

The Director has established an internal international strategy group to coordinate the ODTR international strategy and policies.

The International Strategy Group's primary functions are to:

1. identify key international and European issues/areas for ODTR involvement and monitoring;
2. establish structures for, and maintain awareness of, developments in international regulatory bodies (EU, CEPT, ITU, IRG, ERG, WTO);
3. implement a strategy of active engagement at European and international level.

6.6 NATIONAL LEVEL

6.6.1 The National Spectrum Management Framework

In accordance with international law, the Minister for Public Enterprise is the national representative at international decision-making bodies such as the ITU, the EU Council of Ministers and their affiliated agencies. The ODTR participates actively in these bodies, providing specialist expertise on spectrum management issues and provides the Chairman for the CEPT ECC Project

Team on IMT-2000 and Systems Beyond, which is tasked with developing a coordinated CEPT strategy for the development of 3G and the next generation of mobile communication systems.

The ODTR was established in June 1997 under the Telecommunications (Miscellaneous Provisions) Act 1996 (The 1996 Act). The ODTR (Office of the Director of Telecommunications Regulation) is the National Regulatory Authority for the telecommunications sector in Ireland. The functions of the Director will be transferred to a Commission for Communication under the new Communications Regulation legislation. The ODTR reports on its activities in respect of radio spectrum in its annual report which is presented to the Oireachtas every year and is responsible for making the liberalised market work in accordance with EU and Irish law.

Under the 1926 Wireless Telegraphy Act and the 1996 Telecommunications (Miscellaneous Provisions) Act, the ODTR has been responsible for the production of the radio frequency plan[26] and management of the radio spectrum (except that used by the Defence Forces)[27], subject to certain legislative constraints. The same model is continued under Section 35 of the new Communications Regulation legislation. The spectrum is managed by way of licensing schemes that are formed in regulations that require the consent of the Minister for Public Enterprise who may also issue 1) policy directions with regard to allocation and use of the radio spectrum and 2) decisions to enable the state to discharge its obligations as a member of an international organisation or as a party to an international agreement. Policy directions will be subject to a new publication procedure before adoption under the new legislation.

The key objective of regulation is to benefit the user. The development of competition and provision of choice is essential to achieve this aim. The office manages a wide range of regulatory functions in respect of telecommunications services, including the management of radio spectrum for many uses including broadcasting and the regulation of television distribution. As the National Regulatory Authority (NRA) the ODTR issues, *inter alia*, approvals under the R&TTE Directive for Telecommunications Equipment and the assignment of

[26] Document ODTR 01/23, "Table of Frequency Allocations, Ireland", available on the ODTR web site at: www.odtr.ie/docs/odtr0123.pdf

frequencies to individual licensees in accordance with the Wireless Telegraphy Acts, except those used by the Defence Forces. The Office also maintains a wide range of international contacts to ensure that the Irish regulatory system is the best and most effective it can be.

6.6.2 Legislation Relating to Spectrum Management

The ODTR is responsible for issuing two broad types of licences, namely those which relate to the type of service provided (Telecommunications Service Licences) and those which relate to use of the wireless telegraphy apparatus and radio spectrum (Wireless Telegraphy Licences).

Telecommunications services are subject to licensing and regulation under the Postal and Telecommunications Act, 1983. This Act has been amended by the terms of EU Directives which provided for the liberalisation of the sector. Licensees who operate public telecommunication networks (e.g. fixed wireless access or mobile telephony) are required, subject to limited exceptions, to have a service licence issued under the Postal and Telecommunications Services Act 1983, as amended, and the new Communications Regulation legislation. This licensing framework provides for two categories of licence, Basic and General, to cater for the services offered. There is no limitation on the number of licences which may be granted and applications are dealt with on an open-door basis. As the current regime is not technology-neutral, there is a separate standard mobile telephony licence covering much the same areas as the General licence.

Spectrum use and management within Ireland is governed by the Wireless Telegraphy Acts 1926-1988 ("the WT Acts") and the Telecommunications (Miscellaneous Provisions) Act, 1996 ("the 1996 Act"). Where a telecommunications service involves spectrum use, such as mobile or fixed wireless or the forthcoming 3G service, in addition to a general or mobile licence, a licence for the use of radio frequencies is issued under the Wireless Telegraphy Act. A WT Act licence is required by any user of wireless telegraphy equipment, unless specifically exempted by the definitions in the

[27] Wireless Telegraphy Act 1926, Section 3, paragraph 6

1926 Act or a statutory instrument. A wide variety of WT Act licences are issued by the ODTR, the majority of which are renewable on an annual basis.

The regulation of content on commercial Radio and TV broadcast services are the responsibility of the Broadcasting Commission of Ireland (BCI), who together with RTE have their frequency assignments licensed by the ODTR. Frequency planning for broadcast services is undertaken by the ODTR. Broadcasting licences for off-air reception of radio and television services are issued under the Broadcasting Act 1960 in the case of RTE services. In the case of TV3 and commercial, community and special interest radio services, licences are issued under the Radio and Television Act 1988. For retransmission services, such as cable, MMDS, deflectors and the forthcoming national DTT service, licences are issued under specific regulations made under the Wireless Telegraphy Acts.

Spectrum use by the aeronautical community is licensed with the cooperation of the Irish Aviation Authority (IAA). The IAA provides the technical approval for Aircraft Station licences and the frequency assignment and coordination for all ground-based aeronautical transceivers that should be licensed, with the ODTR holding ultimate responsibility for spectrum use. The IAA also holds some licences itself in relation to the provision of radar and distance measuring equipment.

Ships Radio licences are currently issued by the ODTR with cooperation from the Department of the Marine.

Use of the spectrum by the Defence Forces is outside the Director's remit but is generally notified to the ODTR for co-ordination purposes.

6.6.3 Compliance and Enforcement

A "clean" spectrum environment, free from excessive interference, is vital to the successful deployment of radiocommunication services especially for safety of life. The licensing process enables the coordination of individual radio users use of frequencies so that they do not suffer mutual interference, or in the case of licence-exempt services, to ensure that such services operate in a manner

which is unlikely to cause interference to other radio services. Operation of equipment not conforming to the licence conditions circumvents this co-ordination process and can result in interference to licensed services. Similarly, operation of licensed apparatus outside the terms of the licence, for example, by operating at excessive power levels or with inadequately suppressed out-of-band emissions can lead to serious interference to other users.

The ODTR has enforcement powers to ensure that spectrum is used properly and in conformance with the relevant licence or exemption regulation. The remit of the ODTR in this regard includes the enforcement of licence conditions and the taking of action against unlicensed use of radio apparatus. The ODTR has established a monitoring facility within the office for the purposes of checking that spectrum licensees (such as FWA & GSM operators) are meeting their licence conditions. Activities include the tracing of interference to licensed and safety-of-life services, inspection of licensed installations and the prosecution of offences such as unlicensed operation of mobile radio and broadcast equipment.

6.7 NON IONISING RADIATION AND MAST SITES

Radiocommunication is required for a variety of purposes for the benefit of both private individuals and commercial organisations. The purposes include radio and television broadcasting, telecommunications services including fixed telecommunications, mobile telephony, satellite services, radio navigation systems and equipment used in industry, medicine and commerce. The use of radiocommunication in this country, as in the rest of the world, has accelerated in recent years and as the economy continues to flourish and technology advances, this use will also continue to grow. An example of this growth is evident in the public mobile telephony industry where the market in Ireland has seen unprecedented growth from a penetration level of 22% in 1998 to 79% at the end of 2001.

The future will see further substantial growth in the application of radiocommunications as new technologies are implemented. These include digital television, advanced mobile telephony services, and wireless-based systems capable of providing advanced telecommunications services.

Inevitably, as consumer demand for radio based services increases, the number of masts required to deliver these services will also increase.

The ODTR includes a requirement in relevant licences to ensure compliance with the international guidelines for general public exposure to electromagnetic fields, i.e., the radiation emissions from telecommunications masts must be within the levels set down by the International Commission on Non-ionising Radiation Protection (ICNIRP). Licensees must take full account of the guidelines when designing, constructing, and operating radio installations.

In order to ensure that operators comply with this licence condition, the ODTR conducts regular audits on the telecommunications licensees. To date, three such audits have been conducted, the first in 1998 (Document ODTR 98/23), the second in 1999 (Document ODTR 00/06) and the most recent in October 2001 (Document ODTR 01/85). These audit reports have been published on the website www.odtr.ie.

The audits include:

1. Auditing the procedures put in place by the operators to ensure that their sites are in compliance with the ICNIRP levels;
2. Verifying that the sites are in compliance with the ICNIRP levels by taking measurements at a number of carefully selected sample sites.

These audits require companies to undergo far more stringent examination of how they manage their operations than merely a random testing of masts, and so the audits are more effective in ensuring full compliance with the guidelines. On the basis of these audits, the Director is satisfied that the telecommunications operators have adequate procedures and arrangements in place to ensure compliance with the international guidelines for public exposure limits for non-ionising radiation. The Director hopes that the audit reports serve to inform and reassure the public about the measures being taken by operators of radio installations to comply with these requirements.

It is important to note that the ODTR has no remit in relation to health issues or in relation to the granting of planning permissions for masts. The development of policy regarding health and safety issues is primarily the responsibility of the

Department of Health and Children whilst the local planning authorities are responsible for the granting of planning permissions for masts.

It is clear, in order to meet consumer demand for mobile services, that the associated masts, antennas and associated infrastructure cannot be avoided. It may be the case that some areas will want to opt out completely from such developments, having made a choice against commercial development of their area.

Part C:

7 STRATEGIC DEVELOPMENTS IN RADIO SERVICES

7.1 INTRODUCTION

This section deals with each of the radiocommunication services using the radio spectrum in Ireland.

The general format used for each service is first to give an overview, followed by the current spectrum use by that service, the spectrum management objectives that are applicable and completed with the spectrum management issues that apply to that service. Two documents constantly referred to in this section are the 2001 publication of the National Table of Frequency Allocations[28] and the ERC Report 25, known as the European Common Allocation Table[29].

Each service, while dealt with separately in this document, should not be viewed in isolation, bearing in mind that some bands are shared between different services with different protection status as indicated in the National Table of Frequency Allocations. In addition, sharing criteria between services in the same band and between services in adjacent bands must be considered when there is a potential for harmful interference between two services.

7.2 PUBLIC MOBILE CELLULAR SERVICES

7.2.1 Overview of the Public Mobile Cellular Services

Mobile communications is one of the most rapidly expanding sectors of telecommunications and this is particularly true of cellular radiotelephones. With the introduction of 2nd generation mobile networks such as GSM[30], mobile radio services moved from a specialist market to the general consumer

[28] See ODTR 01/23 – Table of Frequency Allocations for Ireland available on www.odtr.ie

[29] Available on the ERO website, www.ero.dk

[30] GSM – Global System for Mobile Communications is a cellular, digital, land-based mobile communications system.

market. As a consequence the profile and public awareness of mobile communications has increased significantly.

GSM systems operate in two frequency bands at 900 MHz and 1800 MHz and with enhancements now available for GSM networks to improve their data handling capacity, both 2nd and 3rd generation (3G) networks could co-exist and compete in certain sectors for some considerable time. In the longer term, once 3G services are fully established and if there is substantial migration to the 3G networks, the future of the 2nd generation (GSM) networks will need to be reviewed. So-called 2.5G networks employing GPRS are now being deployed which will be able to support data transfer rates up to 115kbit/s, a considerable improvement over the 9.6kbit/s available on a basic GSM network. Furthermore, if EDGE (Enhanced Data rates for GSM Evolution) technology is employed, up to 384kbit/s would be available. 3G networks take this a stage further by supporting data rates of between 144kbit/s in a vehicular environment and up to 2Mbit/s in an indoor environment.

7.2.2 Use of Spectrum by the Public Mobile Cellular Services in Ireland

Spectrum has been designated for use by digital GSM systems in the 900 MHz range, 880-915 MHz paired with 925 – 960 MHz, and in the 1800 MHz band, 1710-1785 MHz paired with 1805-1880 MHz.

For 3rd Generation systems spectrum has been made available in the bands 1900-1980 MHz, 2010-2025 MHz and 2110–2170 MHz.

7.2.3 Third Generation Services (3G) in Ireland

Third generation (3G) mobile, sometimes referred to as IMT-2000[31] or UMTS[32], represents the latest development in the evolution of mobile communications, combining high bandwidth multimedia performance with wide area mobility. The development is underpinned by global initiatives to set aside dedicated radio spectrum and to develop harmonised equipment standards.

[31] IMT-2000 is the international family of third generation mobile standards approved by the International Telecommunications Union.

[32] UMTS is a European standard which is part of the IMT-2000 family. Other IMT-2000 standards may be deployed but the EU requires that at least one UMTS-based 3G mobile network must be licensed in each Member State to facilitate roaming.

The ODTR launched the competition for the selection of four 3G mobile phone licences on the 18th December 2001.[33] In order to encourage market entry at both the service and infrastructure levels, two distinct 3G licence packages, one of which carries incentives to support certain types of MVNOs[34] are being offered. The "class A" licence will include as an evaluation criterion the offering of a voluntary commitment with regard to the access price for MVNOs and where such a commitment is made, additional spectrum comprising up to 2 x 5.2 MHz of spectrum in the 900 MHz band and 5 MHz of unpaired 3G mobile spectrum will be made available to the successful applicant, subject to demonstrable need.

Additional spectrum will also be made available, subject to compliance with a pre-defined spectrum efficiency threshold, to successful applicants who do not already have access to 2G spectrum or who are not connected to undertakings[35] which have such access. In the case of a single new market entrant, this spectrum will comprise up to 2 x 7.2 MHz of spectrum in the 900 MHz band, and up to 2 x 6.0 MHz in the 1800 MHz band. In the case of more than one new market entrant, spectrum in the 900 MHz and 1800 MHz bands will be made available as necessary to cater for individual operators' demonstrable needs.

The competition is designed to ensure that licences are awarded according to objective, transparent, non-discriminatory and proportionate selection criteria, giving due weight to the need to facilitate the development of competition and to maximise benefits for users in accordance with the provisions of the European Communities (Telecommunications Licences) Regulations 1998 (SI No. 96 of 1998), which transposed into Irish law the European Parliament and Council Directive 97/13/EC[36].

[33] Information Note ODTR 01/96 – Four licenses to provide 3G services in Ireland.

[34] An MVNO is defined here as an organisation operating a physical network infrastructure comprising as a minimum a mobile switching centre, home location register and authentication centre (or 3G mobile equivalents), having its own unique mobile network code with distinct IMSI and E.164 number series (where applicable), and issuing its own branded SIM cards (or 3G mobile equivalent), but without a mobile radio access network. This definition is consistent with the Director's objective to promote competition at both the service and infrastructure level.

[35] A connected undertaking is any entity that has a shareholding link with any existing licensed GSM networks in Ireland.

[36] Directive of the European Parliament and Council of 10th April 1997, on a common framework for general authorisations and individual licences in the field of telecommunications services

It is anticipated that the announcement of the results of the competition will be made by the end of June 2002.

Work on the development of IMT-2000 and future systems continues at the European and the global level and it is important that Ireland participates in these developments in order to maintain its position. With this objective in mind, the ODTR chairs ECC Project Team 1 on IMT-2000 and Systems Beyond which plays a key role in developing the European position for the next ITU World Radiocommunication Conference (WRC-2003) and is well positioned to monitor international developments in this field.

7.2.4 Spectrum Management Objectives for Public Mobile Cellular Services:

a. measure the present Quality-of-Service offered in Ireland to ensure that operators are in compliance with their licence conditions;
b. utilise the available GSM and IMT-2000 spectrum to the maximum efficiency obtainable within current technological capabilities;
c. protect and promote Irish mobile cellular end-user interests in national and international fora;
d. continue to develop co-ordination agreements with neighbouring countries for 3rd generation systems in the same vein as the GSM MoU[37];
e. monitor developments in evolution and co-existence of the IMT-2000 family of 3G standards;
f. actively participate in international fora on mobile system development.

7.2.5 Spectrum Strategy Issues in the Public Mobile Cellular Services

880-890 / 925-935 MHz – Extended GSM (EGSM) Band: The former analogue TACS[38] network closed on the 31st July 2001, releasing this spectrum for EGSM services. Some of this additional spectrum has been identified for possible use by future 3G network operators and the remainder could be used for expansion of existing 2G networks if required.

[37] MoU = Memorandum of Understanding
[38] Also known as the 088 network

2 500 – 2 690 MHz: At present, part of the band (2500 – 2680 MHz) is used by MMDS services in Ireland. This band has been identified for expansion of 3G mobile services and the ODTR is developing a long term strategy concerning the future use of this band, taking into account the development of 3G services and the current and ongoing need for MMDS. A review of the future use of the band is planned for 2004.

7.2.6 Fourth Generation Services (4G)

Research is already underway into fourth generation mobile cellular systems which are expected to facilitate the development of new wireless multimedia services, by providing transmission rates up to 10 times higher than the specified 3G data rates. It is likely that this increase in capacity will be provided in the face of a wide range of requirements in terms of mobility and service diversity.

Through participation in the CEPT ECC, the EC, ITU and appropriate working groups, the ODTR is well positioned to continue monitoring international developments in 4G systems.

7.2.7 Broadband Mobility

Among the major market trends in recent years has been the growth of broadband services and the interest in communicating information anytime and anywhere. This has led to the concept of "broadband mobility". This segment of the information and communications technology market looks set to continue to grow over the medium and long term. Given that radio provides the principal means of achieving mobility in communications services, ensuring there is sufficient spectrum in appropriate frequency bands is, and will remain, a major consideration for spectrum managers in the medium term.

In terms of the way the market is developing, broadband mobility can be considered from two standpoints: first, services that develop largely as an extension of mobile telephony; and secondly, services that owe their origins more to the computer industry and the Internet and which may appropriately be referred to as broadband potability. GPRS and 3G mobile developed around small handsets such as the mobile phone, are examples of the former. IEEE

802.11 and HIPERLAN based services currently aimed at portable computer users, are examples of the latter. In the first case, providing continuous coverage at all locations for people on the move is a key priority in terms of the design of the radio systems, and this to some extent dictates which frequencies are suitable for this type of application. In the second case, it is the ability to provide high data rates suitable for web-browsing that is a key factor. Many users of such applications are currently content to have access only at convenient 'hot spot' locations, such as hotels and airport terminals, rather than continuously as they walk along the street for example. In time, we might reasonably expect the two types of broadband mobility to converge, which will pose new challenges for radio systems designers and spectrum managers. Convergence may for example take the form of multi-mode terminals that can provide seamless roaming between wide area GPRS or 3G mobile networks and local area 802.11 or HIPERLAN networks. Some early examples of such terminals are already appearing on the market.

7.3 FIXED SERVICES

In providing transmission capacity, radio instead of cable is often the preferred solution where constraints such as cost, local topography (e.g. mountainous terrain, paths across water) and the need for access to remote rural regions are fundamental considerations. Fixed radio systems provide the operator with the ability to roll-out a network rapidly and the capability to install transmission paths as and when required.

The growing demand for access to the radio spectrum resource is likely to place increasing pressure on all frequency bands. While the demand for spectrum by the mobile services is placing considerable pressure on frequency bands below 3000 MHz currently used by the fixed services, the future demand by the fixed service will mainly be on bands above 3000 MHz.

Above 3000 MHz most of the bands allocated to the fixed service are also allocated on a co-primary basis to other services such as mobile or satellite services. This is creating other pressures for access to the various bands[39] used

[39] For more information consult 'Licensing requirements for radio services –A summary' – (ODTR 00/62)

for fixed services. The fixed service provides transmission paths for various types of traffic such as voice, data or video. The traffic can be either that associated with a public telecommunications network or a private network.

The Fixed Service can be divided into two main groups namely:

a. Point-to-Point links; and,
b. Point-to-Multipoint systems

and in the case of Point-to-Multipoint systems, further subdivided into:

a. Point-to-Multipoint links;
b. Fixed Wireless Access (FWA);
c. Multipoint Microwave Television Distribution Systems (e.g. MMDS and MVDS);
d. Multimedia Wireless Systems (MWS);
e. Multipoint to multipoint links ("mesh" networks).

7.3.1 Point-to-Point Radio Links

A typical point-to-point radio link consists of two stations with a clear line of sight between them and separated by distances ranging from a few kilometres up to 40 kilometres or greater. Each station employs a highly directive antenna for transmission and reception. A chain of such stations can be used to cover greater distances.

Most fixed services operate at frequencies above 1000 MHz with long haul high capacity infrastructure links mainly in bands between 3000 MHz and 11 GHz and shorter access or infrastructure links mainly in bands above 12 GHz. Over the last few years the trend in the demand for fixed links has been steadily upwards. This has been particularly noticeable in the bands used for short haul access and infrastructure links, which are normally above 12 GHz[40]. Over the next decade, pressure on the spectrum allocated to the fixed service will continue to increase through the demand for new applications, such as the satellite or mobile services for which radio is the optimum transmission medium.

[40] Guidelines for applicants for point-to-point radio link licenses in spectrum above 1 GHz - (ODTR 98/14R)

Access networks such as GSM, 3G mobile, FWA and, in the future, Multimedia Wireless Systems (MWS) require infrastructure to connect base stations to the backbone network. Much of this infrastructure comprises microwave fixed links and it is anticipated that the support infrastructure to roll out 3G and other access networks will necessitate very high usage of fixed radio links in the future.

7.3.2 Point-to-Multi-Point Links

Historically Point-to-Multipoint links have been used for the provision of basic telephony to isolated customers. This provided an adequate solution for serving areas with a low customer base and usually does not offer capacity for services other than basic telephony.

Another application for Point-to-Multipoint links is within a network, such as a private network, linking a number of outstations back to a central station. Such systems are typically used for telemetry or SCADA (Supervisory, Control and Data Acquisition) applications. For historical reasons and to provide effective performance over long distances and non-line of sight paths, these links were in frequency bands below 1000 MHz. The number of systems currently licensed is limited and mainly used by some utilities (e.g. electricity, water) for remote control and monitoring of their outstations. It is expected that there will be a small but ongoing requirement for this type of Point-to-Multipoint application (i.e. in-area use) though not necessarily limited to frequencies below 1000 MHz.

7.3.3 Fixed Wireless Access (FWA)[41]

Traditionally the most difficult component of a telecommunications network to build and generally the most expensive to maintain has been the local access network. Most of the local loop connections in place today use cable and copper pairs.

Fixed Wireless Access (FWA) is a means of delivering access to the public switched telephone network by means of radio rather than conventional wire

[41] Also referred to as Fixed Wireless Point to Multipoint Access (FWPMA), Radio in the Local Loop (RLL), or Wireless in the Local Loop (WLL)

line connections. FWA is sometimes referred to as Fixed Wireless Point-to-Multipoint Access (FWPMA), but services may be delivered using other network architectures such as "mesh" configurations or point-to-point links. FWA can be used to replicate the existing wire line local loop or to provide direct access to broadband data networks such as the Internet, or both. FWA thus has the potential to enhance competition in the market by providing alternative access networks to the existing local loop and to provide broadband access in areas where alternative platforms such as digital subscriber line (DSL), cable or fibre might not be feasible.

The availability of multiple platforms - DSL, cable, satellite and FWA - provides some assurance that the technological and commercial challenges faced by each platform can be overcome by the use of substitutes in different parts of the country, and increases the prospects of infrastructure competition, with the attendant benefits for users of better services and competitive prices.

7.3.4 Multimedia Wireless Systems (MWS)

To cater for the increasing convergence between the Fixed Service and the Broadcasting Service, the concept of "Multimedia Wireless Systems (MWS)" has been developed by CEPT and defined as: "Terrestrial multipoint systems which have their origin in telecommunications and/or broadcasting, including MVDS, and which provide fixed wireless access direct to the end user for multimedia services".

Multimedia Wireless Systems[42] are being developed to provide broadband wireless communications that will meet future consumer requirements for bi-directional multimedia applications. Prototype system concepts which emphasise a high degree of spectrum reuse and bandwidth on-demand are being developed and tested. MWS emerged through a combination of developments including subscriber demand for an increased variety of services at lower cost and higher data rates, development of fibre infrastructure which brought broadband transport within the range of a single microwave link hop and liberalisation initiatives promoting competition in the local loop[43].

[42] Also known as Broadband Wireless Access
[43] Also known as local loop unbundling

These Multimedia Wireless Systems may be either purely broadcast systems such as digital MVDS, or systems offering different degrees of interactivity. As multimedia is generally understood to be a mixture of voice, data imaging and/or video offered to a customer with some degree of interactivity, the CEPT has proposed that MWS can use bands allocated to the Fixed Service and /or the Broadcasting Service[44], notably the 40 GHz band (40.5 – 43.5 GHz). Broadband services are usually considered to be those offering data rates in excess of 2 Mbit/sec. However this is very much a minimum figure and it can be expected that terrestrial broadband wireless systems should provide for data rates of 20 to 50 Mbit/sec and above to the end user. Studies undertaken within ETSI indicate that MWS would typically provide up to 36 Mbit/sec to user terminals and 4.5 Mbit/s in the uplink (or return path) direction[45] and be able to compete with or complement broadband wireline access systems using Digital Subscriber Loop (DSL) and other cable modem technologies. The 40 GHz band is one of the few bands available throughout Europe that can offer this amount of unused capacity on a harmonised basis.

Therefore CEPT/ECC has designated the band 40.5 to 43.5 GHz for the introduction of MWS[46]. In line with the ECC Decision, the ODTR has also designated the band for use by MWS in the National Table of Frequency Allocations. Other frequency bands are also under consideration and further details are available on the ERO website (www.ero.dk).

7.3.5 Use of Spectrum for Fixed Services in Ireland

Frequency allocations to the Fixed Service in Ireland are indicated in the National Table of Frequency Allocations[47].

7.3.6 Spectrum Management Objectives for the Fixed Service:

a. review use of fixed service spectrum in light of the importance of spectrum allocations for the Fixed Services, (it is the intention of the ODTR to conduct this review during 2002);

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[44] See CEPT Decision (99)15 on Harmonised frequency band 40.5-43.5 GHz for MWS including MVDS.
[45] CEPT ECC Recommendation (01)04: Recommended Guidelines for the Accommodation and Assignment of Multimedia Wireless systems in the Frequency Band 40.5-43.5 GHz.
[46] ERC/DEC/(99)15 on the designation of the harmonised frequency band 40.5 to 43.5 GHz for the introduction of Multimedia Wireless Systems (MWS), including Multipoint Video Distribution Systems (MVDS)
[47] Document ODTR 01/23.

b. improve the use of the Fixed Service frequency allocations and assignments through a programme of compliance audits and investigations;
c. protect and promote Fixed Service end user interests in international fora;
d. complete the development of an electronic licensing regime which will permit online licence applications and fee payments.

7.3.7 Spectrum Strategy Issues in Fixed Service Bands below 1000 MHz

There are a small number of fixed point-to-point links in the 410-440 MHz and 450-470 MHz bands. A planned approach to the transfer of these links is under consideration in order to make more spectrum available for mobile as opposed to fixed services which, in the light of technological developments, are now more appropriately assigned in bands above 1000 MHz.

7.3.8 Spectrum Strategy Issues in Fixed Service Bands between 1000 and 3 000 MHz

The fixed service bands between 1000 MHz and 3000 MHz are particularly affected by current and emerging demands for other services such as mobile communications and various satellite communication services that have a mobile/portable reception application. As a consequence, in the mid 1990s it was necessary to review how the fixed services were utilising the bands and as a result of this review a number of the bands have been closed for new link applications and the existing links are being phased out over a period of time. The following table summarises the current and planned use of three fixed service bands between 1000 and 3000 MHz where changes are being considered.

Band	Current Use	Planned / Future Use
1350-1517 MHz 1375-1452 MHz	Links	Business radio links presently below 1000 MHz
2300 – 2500 MHz	ISM, Short Range Devices, RURTEL System	Alternative uses to be considered. Major growth in license exempt systems is expected in the 2400 – 2483.5 MHz band.
2500-2680 MHz	MMDS systems	Ongoing MMDS use, future MSS and 3G mobile systems. Band to be reviewed in 2004.

7.3.9 Spectrum Strategy Issues in the Fixed Service bands between 3000 MHz and 10.7 GHz

This is an important spectrum segment for the fixed service. The principal use is high capacity trunk routes with hop lengths typically in the order of 15 to 45 kilometres. The fixed service bands in this segment are also shared with other services, particularly the satellite services. The following table summarises the current and planned use of three fixed service bands between 3000 MHz and 12 GHz where changes are being considered.

Band	Current Use	Planned / Future Use
5925-6425 MHz 6425-7125 MHz	Trunked high capacity, point-to-point, route systems	Phase out analogue links, move to all digital frequency plans.
7425-8500 MHz	Medium and high capacity links	Examining proposed harmonised European band plan and likely impact on current band usage.
10 - 10.65 GHz	Proposed for FWA licence	Review underway, see Document ODTR 02/19.

11 GHz Band (10.7 to 11.7 GHz): The band 10.7 – 11.7 GHz, designated for high capacity point-to-point links, is shared with the Fixed-Satellite Service. It is a very important band in Ireland for trunk routes due to the shorter minimum hop length to that permitted in other bands below 12 GHz. Accordingly it is heavily used. The Fixed Satellite Service also makes extensive use of this

band particularly for VSATs and Direct-to-Home (DTH) television reception. As the satellite use is in the space-to-Earth direction the main potential for interference is from terrestrial radio links into the satellite earth station receivers. Due to the proliferation of satellite receive earth stations in this band, some European Administrations are no longer licensing point-to-point links in this band. The ODTR will keep the use of this band under review for possible conflicts arising between the demands of the satellite and terrestrial services.

7.3.10 Spectrum Strategy Issues in the Fixed Service bands between 10.7 and 40 GHz

The licensing of fixed services in this spectrum segment is a relatively recent occurrence and is directly related to the development of mobile networks, where the principal use is for access links. Significant demand for point-to-point links is envisaged over the next few years. In addition spectrum particularly above 20 GHz, is in demand for point-to-multipoint applications to provide infrastructure for mobile networks. Some fixed service bands in this segment are also allocated to other services and in particular the satellite service. The following table shows two fixed service bands where changes are being considered.

Band	Current Use	Planned / Future Use
14.5-15.35 GHz	Access links	Complete European bandplan alignment
24.5 – 26.5GHz	Fixed Links.	Fixed links and FWA

10.7 – 12.5 GHz: The ECC has approved Decision ERC/DEC (00)08 on 'The use of the band 10.7 – 12.5 GHz by the fixed services and earth stations of the broadcasting-satellite and fixed-satellite service (space-to-Earth)'. This Decision identifies CEPT priorities for the fixed service, fixed-satellite service (FSS) and broadcasting-satellite services (BSS). It notes that within Europe there are high numbers of FSS and BSS terminals already deployed in the 11.7 to 12.5 GHz band and that further GSO or Non-GSO FSS systems are planned

which are intended to deploy large numbers of user terminals. In Ireland, Sky DTH is an example of one satellite service in this band.

The ODTR has been approached to licence a terrestrial broadcasting service in the band 11.7 – 12.5 GHz and recently completed a consultation on this matter[48]. While Ireland has not yet implemented ERC Decision ERC/DEC (00)08, the Director's view is that implementing the ERC Decision would not be incompatible with licensing a broadcasting service in the band 11.7 – 12.5 GHz. For further discussion on this issue see Section 7.6.9 below.

18 GHz Band (17.7 to 19.7 GHz): In addition to the allocation of the band to the fixed service, part of this band (17.7 – 18.1 GHz) is used for broadcasting-satellite service (BSS) feeder links although currently this does not include the Irish feeder link assignments, which are below 17.7 GHz. Part of the band (18.8 – 19.3 GHz) is also allocated to non-geostationary (NGSO) FSS systems (space-to-Earth). Typical of the satellite application are systems intended as direct-to-home broadband delivery systems. It is recognised that it will be difficult for the terrestrial fixed service to share spectrum with the NGSO FSS applications as the FSS systems intend to deploy large numbers of user terminals on an uncoordinated basis.

A CEPT ERC Decision[49] is being considered by the ODTR that will establish sharing criteria between the two services which will effectively prohibit uncoordinated fixed-satellite services from claiming protection from the fixed services, and require the implementation of interference mitigation techniques by the fixed-satellite services.

26 GHz Band (24.5 to 26.5 GHz): This spectrum is under review in a current consultation[50], proposing that the current frequency assignments be rationalised and inviting views on how the remaining spectrum designated for FWA may be used in the future.

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[48] Please see Document ODTR 01/69 – 'Licensing regional or locally based digital television delivery' and Document ODTR 01/97 – 'Response to the consultation on Licensing regional or locally based digital television delivery'

[49] ECC Decision ERC/DEC(00)07 on the shared use of the band 17.7-19.7 GHz by the fixed service and Earth stations of the fixed-satellite service (space to Earth)

[50] Document ODTR 02/19 – Expanding Opportunities in the Radiocommunications Market: FWA.

28 GHz Band (27.5 to 29.5 GHz): In addition to the allocation of the band to the fixed service, part of the band (28.6 – 29.1 GHz) is also allocated to NGSO FSS systems in the Earth-to-space direction. Typical of the satellite application are systems which are planned as direct-to-home broadband delivery systems.

A CEPT ERC Decision[51] that will 1) divide the band and establish exclusivity for the two different services in parts of the band, and 2) establish sharing criteria between the two services in shared segments of the band and which will limit the use of uncoordinated fixed-satellite services from claiming protection from the fixed services, is being considered by the ODTR.

7.3.11 Spectrum Strategy Issues in the Fixed Service Bands above 40 GHz

Little use is currently being made of this segment of spectrum within Ireland and indeed Europe, but greater use is expected in the near future. With the demand for spectrum for high bandwidth, short haul applications and facilitated by developments in manufacturing technology, exploitation of the bands up to 70 GHz is envisaged over the next few years. The current limited use of this segment throughout Europe presents a unique opportunity to exploit suitable bands for pan-European type applications. The following table summarises six bands used for fixed services above 40 GHz where changes are being considered.

Band	Current Use	Planned / Future Use
40-43.5 GHz	Not used	Reserved for MWS
47.2-50.2 GHz	Not used.	Considering potential of HAPS
50, 52, 60, 65 GHz	Proposed for Fixed Links	Monitoring regulatory developments in Europe

7.4 BROADCASTING

The broadcasting service is a major user of the radio frequency spectrum. Due to the importance attached to it from a political, social and cultural perspective

[51] ERC Decision (00)09 on the use of the band 27.5-29.5 GHz by the fixed service and uncoordinated Earth stations of the fixed-satellite service (Earth to space)

it has been, and no doubt will continue to be, afforded a prominent position in both international and spectrum allocation policies. The Broadcasting Commission of Ireland is responsible for the licensing and authorisation of broadcasting services while the ODTR remains responsible for the allocation, assignment and licensing of the associated radio frequencies.

Until recently all forms of broadcasting have used analogue modulation techniques. Various enhancements (colour, teletext, NICAM, etc. for television, stereo and RDS, etc. for VHF-FM sound broadcasting) have been introduced over the years. All of these enhancements have been backward compatible with the basic system so that the introduction could be phased in, so as not to require the viewer/listener to change their receiving equipment unless they wished to avail of the new enhancements.

Digital broadcasting is currently a major technological change in the broadcasting area. However as it is not backward compatible with the existing analogue systems, a simulcasting approach is being adopted to reduce disruption to the consumer. Where there is presently a large established user base and a lengthy product replacement cycle, the time required for transition from one technology to the next can be considerable. In relation to Digital TV it can be expected that the digital technology currently being introduced will form the basis of digital television transmission for a considerable time. However it should not be assumed that this technology will remain static. As occurred with analogue television, it can be expected that additional enhancements to the basic digital transmission technology will evolve over the lifetime of the system.

7.4.1 Developments in Broadcasting – DTT Return Channels

The provision of a return channel permits instant consumer interaction with broadcast services, e.g., Televoting. The return channel might also facilitate information society services such as web-browsing. A number of systems have been proposed using technologies such as the telephone network, the GSM network and xDSL to provide the return channel. Recently the concept of terrestrial return channels reusing the broadcasting network to receive VHF/UHF signals transmitted from set top boxes has been proposed and an ETSI standard developed. This takes advantage of similar propagation path

characteristics for forward and return signals and reuses the existing terrestrial infrastructure.

The ODTR is monitoring developments within the ITU, DVB Project[52], ETSI and other related research projects developing aspects of this technology.

7.4.2 Sound Broadcasting in Ireland

The sole Irish Long Wave (LF) assignment is licensed to RTE for use by Teamtalk 252.

Limited use is made by RTE of the Medium Wave (MF) band for the national services and the BCI is inviting applications for local services in a number of counties in the MF band.

There are no Short Wave (HF) broadcasting stations in Ireland.

VHF-FM in the band 87.5 – 108 MHz (also known as Band II) is the dominant sound broadcasting mode in Ireland. This band is used for national networks (four public service networks and one commercial network), as well as for local and community radio. Currently about 70% to 75% of the band is used in Ireland. There is capacity for further expansion, to various degrees, in most parts of the country.

Digital Audio Broadcasting (DAB) is heralded as the next significant development for sound broadcasting although in Europe the take up has to date been limited. As DAB multiplexes can carry typically 5 to 6 programme services, the multiplex could also be used to deliver additional data type services.

A CEPT planning meeting was held in Wiesbaden in 1995 in order to provide each European Administration with two DAB allotments. Ireland obtained two national DAB allotments in the VHF band (223 to 230 MHz, part of Band III). In the longer term, with the phasing out of analogue television from band III, it should be possible to increase the amount of spectrum for DAB. To date no plans have been made for local or regional DAB services and a recent report[53] to Government recommended that a digital radio working group, comprising of all key stakeholders be established, to advise the Government. The outcome of

[52] See http://www.dvb.org

[53] Report on the findings of the DAB Forum, compiled by Deloitte & Touche, 17 August 2001.

the working group activities should set the groundwork for the development of a comprehensive strategy for digital radio in Ireland. The CEPT intends to hold another planning meeting in June 2002 to plan the use of the 1.5 GHz (1452 MHz to 1479.5 MHz) band for digital sound broadcasting and it is possible that spectrum in this band would be used for regional/local networks. The ODTR is participating in this planning process with Government and industry to assess how best to implement these services.

7.4.3 Satellite Sound Broadcasting in Ireland

Until recently satellite sound broadcasting has mainly consisted of using one of the auxiliary sound carriers available on a satellite television transponder or in digital satellite TV signals to provide a sound broadcasting service which is not suitable for portable/mobile reception, which is one of the key marketing strengths of sound broadcasting. To offer sound broadcasting to portable and mobile users a number of new satellite systems have recently been implemented. Examples of these new systems include Worldspace and Sirius. Interest in Europe however, currently appears to be focused on terrestrial broadcasting (sound).

7.4.4 Spectrum Management Objectives for Sound Broadcasting

a. monitor the development of digital modulation techniques that have the potential to replace the analogue service with high quality broadcast services in the short wave, medium wave and long wave broadcast bands;
b. ensure present operator compliance and protect authorised services from illegal spectrum use;
c. prepare for the T-DAB planning meeting in 2002.

7.4.5 Television Broadcasting in Ireland

There are 4 national analogue networks: RTE 1, Network 2, TV3 and TG4. RTE 1 and RTE 2 have mature transmission networks. TnaG, later branded as TG4, was established in 1996 and TV3 commenced operation in 1998.

The TV3 and TG4 transmission networks use only the UHF band (bands IV & V),[54] while RTE 1 and Network 2 use a mixture of the VHF (Band III) and UHF bands (Bands IV & V). The last VHF Band I transmitter has now been phased out. A number of UHF deflector systems using the UHF Bands IV &V have been licensed to cover rural areas.

An ITU planning conference is scheduled for May 2004 and again during 2005 to re-plan the broadcast bands III, IV, V covered by the 1961 Stockholm Agreement. The plan that is agreed at the proposed conference will form the basis for VHF/UHF broadcasting for possibly the next 20 to 30 years. The ODTR has assigned resources to plan for the conference.

Digital Terrestrial Television (DTT) is the next significant development in television broadcasting. Each DTT multiplex can carry a number of programme services although the typical figure is four. A DTT multiplex can also be used to deliver additional data type services. At a CEPT meeting in 1997[55] the general criteria for planning DTT were established. However, unlike the DAB planning meeting of 1995, it did not develop an assignment or an allotment plan. It is up to each Administration to develop and co-ordinate its plan within the framework developed at the 1997 meeting. Following on from a consultation[56] and the published response[57] to the consultation, six DTT multiplexes using the UHF broadcast band (Bands IV & V) may be licensed for national distribution of programme services.

A decision will not be made to switch off the current analogue television service before three years after the commercial launch of DTT and then only after 98% of the population is covered and there is an 85% to 90% take-up of digital services across all digital platforms.

7.4.6 Use of Spectrum for Multipoint Microwave Television Distribution Systems (MMDS)

[54] Bands III = 174-230 MHz, Band IV = 470 – 582 MHz, Band V = 582 – 862 MHz

[55] The Chester 1997 Multilateral Co-ordination Agreement Relating to Technical Criteria, Co-ordination Principles and Procedures for the Introduction of Terrestrial Digital Video Broadcasting (DVB-T)

[56] Document ODTR 99/57 – Licensing Digital Terrestrial Television

[57] Document ODTR 01/17 – Response to Consultation on Licensing Digital Terrestrial Television

MMDS are basically point-to-multipoint systems used to distribute television programmes and were developed to bring multichannel television services to rural areas not covered by cable systems. They are inherently one-way transmission systems. In Ireland, MMDS networks have been deployed using the 2500 to 2680 MHz band and both current operators are licensed to provide 11 channels in any cell. From 1 January 2005 the allocation of the bands 2500-2520 MHz and 2670-2690 MHz to the mobile-satellite service (space-to-Earth) on an international basis becomes effective. These bands may be used by administrations wishing to implement the satellite component of IMT-2000. This may have an impact on MMDS services in these bands and the current MMDS licence conditions reflect this potential issue.

The band 2500 MHz to 2690 MHz has been designated by the ITU for use by IMT-2000 (3G) services and has been identified by CEPT as the primary band for expansion of 3rd generation mobile communications services in Europe. The long term impact of these future services on MMDS in Ireland is being carefully evaluated.

7.4.7 Multimedia Wireless Systems (MWS)

Multimedia Wireless Systems[58] are being developed to provide broadband wireless communications that will meet future consumer requirements for bi-directional multimedia applications. Prototype system concepts which emphasise a high degree of spectrum reuse and bandwidth on-demand are being developed and tested. MWS emerged through a combination of developments including subscriber demand for an increased variety of services at lower cost and higher data rates, development of fibre infrastructure which brought broadband transport within the range of a single microwave link hop and deregulation that is promoting competition[59] in the local access.
CEPT has been active in this area and has designated the band 40.5 to 43.5 GHz[60] for the introduction of Multimedia Wireless Systems (MWS), including Multipoint Video Distribution Systems (MVDS). In line with this Decision, the ODTR has added this frequency band for MWS use in the National Table of

[58] Also known as Broadband Wireless Access
[59] Referred to in Ireland as local loop unbundling
[60] ERC/DEC/(99)15 on the designation of the harmonised frequency band 40.5 to 43.5 GHz for the introduction of Multimedia Wireless Systems (MWS), including Multipoint Video Distribution Systems (MVDS)

Frequency Allocations, although at present [61] there is little demand for the service. Other frequency bands are also under consideration and further details are available on the ERO website (www.ero.dk).

7.4.8 Spectrum Management Objectives for Television Broadcasting

a. complete international co-ordination of the initial plan for Digital Terrestrial Television coverage in Ireland;
b. continue planning and co-ordination for further rollout of DTT;
c. ensure present operator compliance and protect authorised services from interference;
d. prepare for the Stockholm 1961[62] re-planning exercise, which includes Band III.

7.4.9 Use of Spectrum by Satellite Television Broadcasting in Ireland

The allocations to Ireland for the Broadcasting-Satellite Service are shown in the National Table of Frequency Allocations[63].

10.7 – 12.5 GHz:

At the present moment this band is used in Ireland, as elsewhere in Europe, for DTH service delivery under an allocation to the fixed-satellite service. Please see section 7.6.9 concerning other uses of this band.

7.4.10 Spectrum for Services Ancillary to Broadcasting (SAB)

The production of broadcasting programmes, films, etc., is often dependent on access to spectrum for various support facilities. These additional facilities which are now regarded as an integral part of broadcasting/programme-making are generally referred to as Services Ancillary to Broadcasting (SAB). The uses that conveniently fall under the heading of SAB are not restricted to broadcasters. Independent programme makers, film producers and organisers of special events can also require them. Typically the facilities required include:

[61] Document ODTR 01/70 – 'New Opportunities in the Radiocommunication market – Fixed Wireless Access (FWA) – response to consultation'
[62] ITU Stockholm 61 Plan - Plans annexed to the Regional agreement for the European Broadcasting Area concerning the use of frequencies by the broadcasting services in the VHF and UHF bands.
[63] Document ODTR 01/23.

a. Outside broadcast links including Electronic News Gathering (ENG);
b. Satellite News Gathering (SNG) including radio microphones and radio cameras;
c. Various 2 way control circuits (e.g. Talk-back);
d. Radio microphones.

With the increasing use of spectrum generally and an increase in activity in the programme/film production sector, the requirement for SAB spectrum is growing. SNG and ENG operations have been assigned frequencies in the 14.0-14.25 GHz and the 14.3-14.5 GHz bands. In general it is likely that the temporary use of VHF/UHF broadcast bands for radio microphones and other SAP/SAB systems including sound outside broadcasting links can be facilitated on a case by case basis.
The ODTR is cognisant of developments on a European level dealing with spectrum requirements for SAB and outside broadcasting.

7.5 BUSINESS RADIO

7.5.1 Overview of Business Radio

Despite the rapid growth of cellular telephony, business radio is still a popular communication system for applications where most traffic is between a control point and one or more mobile terminals, or where groups of mobile terminals need to communicate on a "one to all" basis. The main uses of business radio are for public safety and security (e.g., the Garda Síochána, fire and ambulance emergency services), public utilities (power, water, transport etc.), industrial and commercial users as well as various voluntary organisations, all of whom need reliable means of communicating with personnel and more especially groups of personnel on the move. Business radio includes Private mobile radio (PMR), Community Repeaters and Public Access Mobile Radio (PAMR).

Recent years have seen a number of developments that have enhanced the reliability and security of PMR and PAMR systems. For the most demanding user (security and emergency services) features such as specialised data encryption & transmission and interworking are important. Trunked systems, whereby users have access to a pool of channels rather than the users each having their own specific channel can increase the effective use of

PMR/PAMR spectrum. On-site trunked radio systems have been in operation for a number of years and there are a small number of local area trunked PMR and PAMR systems. In a recent consultation, respondents were generally positive about the future prospects for the trunked mobile radio market in Ireland, with one putting forward an estimate of up to 40,000 users in the long term. It is expected that interest in these services will grow in the future. Some demand is also expected for digital systems that may be based on the TETRA (Terrestrial Trunked Radio) standard or similar systems.

In August 2001, the ODTR published a document outlining its intention to licence public mobile data and automatic vehicle location systems in the UHF and mid-band VHF PMR bands[64]. The Director believes that the availability of specialist public mobile data/AVL networks will complement existing, non-specialised public mobile services and further enhance choice in the mobile communications market. Licensed networks will be required, as a minimum, to be capable of vehicle or asset location to within ±50 metres and to send and receive short messages of up to 160 characters.

7.5.2 Use of Spectrum by Private Mobile Radio (PMR and PAMR) in Ireland

The main mobile bands used by PMR and PAMR are listed in the table below:

Frequency Band and Frequency Range	National Mobile Usage
68 to 87.5 MHz (VHF Low Band)	Government Services PMR commercial PAMR community repeaters.
138 to 156 MHz (VHF Mid-Band)	This band is being planned for PMR use in Ireland.
156 to 174 MHz (VHF High-Band)	Government Services Maritime Mobile Inland Waterway Applications PMR commercial
380 to 399.9 MHz	Digital Trunked Radio
410 to 430 MHz	Analogue Trunked Radio Systems Digital Trunked Radio.

[64] Document ODTR 01/71 – New opportunities in the radiocommunications market

Frequency Band and Frequency Range	National Mobile Usage
446 – 446.1 MHz	PMR 446 – Licence exempt service[65].
450 to 470 MHz (Main UHF band)	Government Services PMR commercial PAMR Community repeaters. Fixed Links supporting PMR
870 to 876 MHz and 915 to 921 MHz	Digital Trunked Radio (Planned)

7.5.3 Overview of Paging

Paging systems currently allowed in Ireland are mainly private on-site or local area systems. On-site paging is typically used by institutions such as hospitals, while local area paging is typically used for emergency service call-out. With the growth in cellular communications systems there has been a steady decline in paging systems in general across Western Europe and a pan-European paging standard, ERMES (European Messaging Service), has failed to attract significant market interest with the consequence that the spectrum allocated to this service is currently under review internationally.

7.5.4 Use of Spectrum by Paging Services in Ireland

The frequency bands used for paging in Ireland are listed in the table below:

Frequency Band	National Paging Usage
86 - 90 kHz	Paging (Commercial Firms)
26.175 - 27.5 MHz	Paging (private, on-site)
27.5 - 28 MHz	Paging (private, on-site)
30.01 - 37.5 MHz	Paging (Hospitals)
153-154 MHz	Paging and alarm systems (National, wide area, local and on-site)
169.4 - 169.8 MHz	ERMES - Subject to review in light of market developments
458.5-459.5 MHz	On-site paging

[65] SI 93 of 1998 exempts SRB in this band from requiring a licence. These devices are limited to 500mW maximum erp.

7.5.5 The Use of Spectrum by PMR 446 in Ireland

PMR 446 was implemented as a new concept for short range voice communications where operation is under relaxed licensing conditions on collective frequencies shared by many users on an uncoordinated basis. The equipment uses an integral antenna in order to maximise sharing and minimise interference and is intended for voice communications only.

The band 446.0 - 446.1 MHz was identified as a Europe-wide harmonised frequency band for such an application and ETSI have prepared ETS 300 296 to facilitate the standardisation of this service, which is licence exempt within Ireland.

7.5.6 Spectrum Management Objectives for Business Radio in Ireland:

a. improve the use of the land mobile spectrum through a programme of spectrum monitoring, investigations and targeted audits leading to improved band usage and better quality of service on individual assignments;
b. investigate possibilities of and encourage the introduction and use of spectrally efficient technologies;
c. continue the commitment to providing a diverse range of services in the land mobile radio bands;
d. develop methodologies for the identification of congestion on PMR channels including the use of monitoring data;
e. ensure that frequency requirements for current and future Public Access Mobile Radio Network operators are met;
f. protect the interests of Irish PMR users in international fora and bilateral discussions.

7.5.7 Spectrum Strategy Issues in Business Radio

138 to 156 MHz, It is intended that this band will be used for both PMR and PAMR services in the future.

410 to 430 MHz, A number of fixed links exist in this band and they may need to be phased out should demand grow for digital and/or analogue trunked radio systems in this band.

450 to 470 MHz, There is currently an investigation within the UK to align this band with the CEPT band plan. At present the Irish and UK UHF base/mobile band segmentation is aligned. However these segments do not align with those used in continental Europe and as a result the UK suffers interference from the continent and vice versa. To overcome this problem the UK intends to adopt the band segment configuration presently used in continental Europe. The Radiocommunications Agency in the UK proposes to use the period up to 2004 to continue the development of a realistic implementation plan. Unless Ireland makes similar changes then the problem moves from being a UK/Continent interference problem to potentially being a problem between Ireland and the UK, particularly Northern Ireland. Comments on the draft Spectrum Strategy expressed concern at the possible implications that the band alignment will have on Irish PMR users. The ODTR is monitoring the process and if changes are to be made in Ireland then timely implementation plans will be developed after consultation with the industry on appropriate measures to be taken.

7.6 SATELLITE COMMUNICATIONS

7.6.1 Overview of Satellite Communications Sector

Satellite services are classified into applications of a general telecommunications or broadcasting nature, for example fixed-satellite service, mobile-satellite service, broadcasting-satellite service, etc.

7.6.2 Fixed-Satellite Service (FSS)

The fixed-satellite service (FSS) forms an important part of telecommunications networks. While initially it was used extensively for intercontinental/international applications, in more recent years some countries have deployed satellite systems for domestic purposes. With the development of fibre optic cables, with their inherently high capacity, the use of satellite communications for intercontinental applications has reduced. However, as

with other satellite services, the FSS is well suited to delivering communications over a wide area, be it country or region-wide. The fixed satellite service will continue to play an important role in the future delivery of broadband telecommunications services including direct-to-home (DTH) delivery. This type of application results in a proliferation of small earth stations/consumer terminals.

7.6.3 Mobile-Satellite Service (MSS)

The mobile-satellite service includes the Land mobile-satellite service, Maritime mobile-satellite service and Aeronautical mobile-satellite service. Aeronautical and maritime mobile-satellite services also provide important safety functions such as the Global Maritime Distress and Safety Service (GMDSS).

The mobile-satellite service (MSS) includes Land mobile, Maritime mobile and Aeronautical mobile satellite services as well as generic services such as Globalstar. Maritime and aeronautical satellite services, in addition to normal communications, also provide important safety functions such as the Global Maritime Distress and Safety Service (GMDSS). The mobile-satellite service provides a variety of voice, data, fax and messaging services throughout the world that complement the terrestrial cellular networks. The satellite component of 3rd generation mobile is expected to comprise of constellations of non-geostationary satellites using spectrum between 1 and 3 GHz.

7.6.4 Broadcasting-satellite service

Broadcasting by satellite encompasses individual reception, often called direct-to-home (DTH), or direct broadcasting by satellite (DBS) and community reception. Individual reception typically involves simple receiving installations with small antenna, requiring a strong signal from the satellite and very effective protection against interference.

FSS bands have been used extensively and are still being used for the distribution of DTH services. This activity was driven by the availability of surplus satellite transponder capacity and the relative ease in which

coordination could be accomplished in the FSS bands as opposed to the BSS bands.

7.6.5 Use of Spectrum for Satellite Communications in Ireland

Frequency allocations for space radiocommunication services in Ireland are indicated in the National Table of Allocations[66]. They conform to the ITU Allocations for Region 1 and to the "European Table of Frequency Allocations and Utilisation[67]". As indicated in the National Table of Allocations, a significant number of the bands allocated to the space radiocommunication services are also allocated to one or more terrestrial services. This is particularly relevant in the case of bands used for telecommunication applications. The specific utilisation for the various bands is subject to particular implementation arrangements, such as the relevant intra / inter-service sharing and co-ordination considerations. These are normally derived from ITU and CEPT/ERC specified criteria.

7.6.6 Satellite Communications Spectrum Management Objectives:

a. protect national Fixed-Satellite Service (FSS) and Broadcasting-Satellite Service (BSS) end user interests in international fora;
b. facilitate electronic licensing through the CEPT One-Stop-Shopping initiative;
c. develop a suitable regulatory regime for emerging new Satellite Services.

7.6.7 Broadcasting-Satellite Service Spectrum Strategy Issues

BSS band (1452 to 1492 MHz): This band is allocated internationally on a co-primary basis to the Fixed Service, the Mobile Service, the Broadcasting Service and the Broadcasting-Satellite Service (BSS). In Ireland the band is closed to use by the fixed service and is being cleared of existing users to facilitate the implementation of Terrestrial Digital Audio Broadcasting (T-

[66] Currently Document ODTR 01/23.
[67] ERC Report 25 - The European table of frequency allocations and utilisations covering the frequency range 9 kHz to 275 GHz.

DAB) as per the 1995 Wiesbaden[68] and 1996 Bonn[69] agreements. A further T-DAB planning meeting to allocate 7 additional T-DAB blocks will be held in June 2002 to provide for further allotments.

BSS-TV band (21.4 to 22.0 GHz): This band is allocated to the Broadcasting-Satellite Service (BSS), the Fixed Service and the Mobile Service. The allocation to the BSS shall come into effect on 1st April 2007. The band is intended for High Definition Television.

7.6.8 Mobile-Satellite Service Spectrum Strategy Issues

Segments between 1000 and 3000 MHz: The frequency ranges of these bands are 1525 to 1559 MHz (space-to-Earth) 1610 to 1660.5 MHz (Earth-to-space), 1980 to 2010 MHz (Earth-to-space), 2170 to 2200 MHz (space-to-Earth), 2483.5 to 2500 MHz (space-to-Earth), 2500 to 2520 MHz (space-to-Earth) and 2670 to 2690 MHz (Earth-to-space).

The following bands have been identified as candidate bands for providing the additional spectrum for the satellite component for IMT 2000:

a. 1525 - 1559 MHz (space-to-Earth) paired with 1626.5 - 1660.5 MHz (Earth-to-space);
b. 1610 – 1626.5 MHz (Earth-to-space) paired with 2483.5 to 2500 MHz (space to Earth);
c. 2500 to 2520 MHz (space-to-Earth) paired with 2670 to 2690 MHz (Earth-to-space).

Work is ongoing within the ECC Project Team on IMT-2000 and Systems Beyond to progress these issues and the ODTR is taking an active role within this project team.

[68] Finals Acts of the CEPT T-DAB Planning Meeting, Wiesbaden 1995.
[69] Finals Acts of the T-DAB Planning Meeting, Bonn, 1996

7.6.9 Fixed-Satellite Service Spectrum Strategy Issues

3400 MHz band (3400 to 3600 MHz): In the past this band was regarded as a military band in parts of Europe and consequently there has been little commercial use of the band. This band has been identified by the Working Group on Frequency Management of the ECC as a preferred band for FWA in Europe. Ireland has licensed two FWA operators in part of the band. Sharing with the fixed-satellite service is likely to be difficult.

11 GHz Band (10.7 to 11.7 GHz): This band is shared with the fixed service where it is designated for high capacity point-to-point links. It is a very important band in Ireland for trunk routes due to the shorter minimum hop length compared to that permitted in other bands below 12 GHz. Accordingly it is heavily used. The fixed-satellite service also uses this band extensively. It is an important band for earth station reception particularly for VSATs and television reception. As the satellite use is in the space-to-Earth direction, the potential for interference is from the terrestrial fixed links into satellite earth station receivers. Due to the proliferation of satellite receive earth stations in this band some European Administrations are no longer licensing fixed links in this band. The ODTR will keep the use of this band under review for possible conflicts arising between the demands of the satellite and terrestrial services.

10.7 – 12.5 GHz: The ERC has approved Decision (00)08 on 'The use of the band 10.7 – 12.5 GHz by the fixed services and earth stations of the broadcasting-satellite and fixed-satellite service (space-to-Earth)' which proposes:

a. that in the band 10.7-11.7 GHz that new fixed services be limited to high capacity (140 Mbit/s or higher) point-to-point links used for trunk networks and that uncoordinated fixed-satellite service Earth stations will operate on a non-protected basis;
b. that in the band 11.7 – 12.5 GHz, no new fixed service systems are to be deployed, giving priority instead to the fixed-satellite and broadcasting-satellite services.

The ODTR has been approached to licence a terrestrial broadcasting service in the band 11.7 – 12.5 GHz. The technical details of this issue are further

discussed in the consultation and associated response on 'Licensing Regional or Locally Based Digital Television Delivery[70]' Recognising that there are potential problems in licensing dissimilar competing systems, nevertheless the Director intends, in advance of considering the award of licences, to invite parties interested in providing 12 GHz systems to engage in discussions with the ODTR and to review the issues causing technical concern as well as business and customer care matters. In the event of a decision to licence this system it may be necessary to impose power restrictions on the technical characteristics and technical conditions would need to be attached to the licence in order to reduce the potential risk of interference to other services using this band. The ODTR will examine this issue further before deciding to award any licence

13 GHz Band (12.75 to 13.25 GHz): This band is allocated to the fixed-service, the mobile service and the fixed-satellite service. As the transmissions are in the Earth-to-space direction, the potential for interference is from satellite earth stations into the terrestrial link receivers. The related downlink allocation (space to Earth) is in the 11 GHz band. The use of the band (12.75 to 13.25 GHz) by the satellite service is governed by the ITU Allotment Plan (RR Appendix S30 B). Ireland has recently opened this band up for use by the fixed service.

18 GHz Band (18.1 to 19.3 GHz): The band is allocated to fixed-satellite service in the space-to-Earth direction although the segment 18.1 to 18.4 GHz is also allocated to the Earth-to-space direction. Part of the band (18.8 – 19.3 GHz) is allocated to NGSO FSS[71] systems (space to Earth). Typical satellite applications will be planned systems such as "Teledesic" or "Skybridge", which are intended as direct-to-home broadband delivery systems. It is recognised that it will be difficult for the terrestrial and other space services to share spectrum with the NGSO FSS applications and there has been a strong lobby in international fora to recover some spectrum in this band from the fixed service in order to facilitate the satellite operators. Accordingly a final decision is needed at a European level on possible segmentation of the band between the

[70] ODTR 01/69 – 'Licensing Regional or Locally Based Digital Television Delivery- Consultation Paper' and ODTR 01/97 – 'Licensing Regional or Locally Based Digital Television Delivery-Response to Consultation'

[71] NGSO FSS: Non Geostationary satellite orbit, Fixed-Satellite Service.

fixed service and the space service. The ODTR is awaiting the outcome of the CEPT deliberations before taking a decision on possible changes in use of this band.

17.7 – 19.7 GHz: The ERC has approved Decision (00)07 on 'The shared use of the band 17.7-19.7 GHz by the fixed-service and Earth stations of the fixed-satellite service (space-to-Earth)' which proposes:-

a. that stations in the fixed-satellite service (space-to-Earth) which are not coordinated shall not claim protection from stations of the fixed service;
b. that both fixed-satellite services and fixed services must implement mitigation techniques as outlined in the Decision.

The ODTR is investigating the practicalities of implementing the Decision.

19.7 – 20.2 GHz: The ERC has approved Decision (00)04 on 'Exemption from Individual Licensing of Satellite User Terminals (SUTs) operating within the Frequency Bands 19.70 - 20.20 GHz space-to-Earth and 29.50 - 30.00 GHz Earth-to-space'

The ODTR received comments to the draft Spectrum Strategy on this issue, commenting that interactive two-way satellites services using VSAT will experience a major and sustained growth from residential and enterprise end users. The respondents further submit that broadband satellite services will be used by diverse levels of society for internet access and high speed connectivity and it will be a highly valuable service where ADSL is not feasible or not cost-effective. The ODTR is investigating the practicalities of implementing the ERC Decision.

27.5 – 29.5 GHz: The ERC has approved Decision (00)09 on 'The use of the band 27.5 – 29.5 GHz by the fixed service and uncoordinated Earth stations of the fixed-satellite service (Earth-to-space)' which proposes:-

a. that sections of the band are designated for exclusive use by uncoordinated Earth stations of the fixed-satellite service;
b. that sections of the band are designated for exclusive use by fixed-satellite systems; 3) that a section of the band be shared between both the fixed service and uncoordinated fixed-satellite service with limitations in certain geographical areas.

The ODTR is investigating the practicalities of implementing the ERC Decision.

47.2 - 50.2 GHz: The band is allocated to the Fixed Service, the Mobile Service and the Fixed-Satellite Service (Earth to space direction). Parts of the band (47.2 – 47.5 and 47.9 – 48.2 GHz) are designated by the ITU for use by stratospheric repeaters (High Altitude Platforms - HAPS). The band sharing criteria between different services have yet to be established.

7.7 SHORT RANGE DEVICES

The term "Short Range Device" (SRD) has been adopted by both the CEPT and ETSI. It is intended to cover radio transmitting devices which provide either uni-directional or bi-directional communication over short distances and which have low capability of causing interference to other radio spectrum users.

A wide range of SRD applications have been made exempt from individual licensing, typically because the power and propagation characteristics of these services is so localised that they do not materially interfere with other spectrum users. With advances in radio technology, there is growing commercial interest in developing products that utilise SRD technology. Some of the services developed for permitted short range device spectrum can be partial substitutes for and/or complements to licensed spectrum applications, such as mobile phones. The absence of spectrum usage charges may encourage commercial operators to focus on using an SRD type of application. Equally, the lack of protection from interference offered to users of such spectrum may militate against operators providing a commercial service, since they may face difficulties in guaranteeing the quality of transmissions. To this end, a Briefing Note on wireless local area networks[72], (WLANs) and a consultation paper on fixed wireless access[73], part of which considers the use of the 5.8 GHz band for WLANs, have been recently published by the ODTR.

The main application of WLANs is in the provision of broadband data transfer within buildings, including offices, hotels, shops and homes. For example,

[72] Source: ODTR Document No. 02/16

WLANs enable laptop computers to be connected to communications networks, without being constrained by cables and fixed access points. It is envisaged that new high speed applications (e.g. for people who need to work while travelling) will harness the broadband access afforded by WLAN technology. WLAN technology is also used externally, extending the reach of local area networks. This application is useful for interconnecting LAN terminals in different buildings (e.g. on a university campus) and as a way of possibly providing broadband Internet access to residential users.

In general, use of permitted SRDs in Ireland is on a non-interference, non-protected basis. Users of such spectrum must not cause interference to other authorised spectrum users, nor can they claim protection from interference from such services. With short range propagation and, in most cases, few devices in any given location, the risk of interference caused by SRD use has been shown in studies to be relatively low. Technological advances offer the prospect of increasing the intensity of spectrum use in these bands by using systems which are automatically self-protecting and self-regulating. These systems will be capable of avoiding interference coming into the band and avoiding transmitting in the presence of other signals within the band. Nevertheless, the growing popularity of short range wireless networks may lead to congestion in some frequency bands, e.g., the 2.45 GHz 'ISM' band which is used by an increasing range of SRD applications.

The use of spectrum for SRD poses a number of regulatory challenges including:

a. how to regulate growing congestion in spectrum where short range devices are permitted to operate;
b. to target regulation where it is needed, helping spectrum users to efficiently resolve their competing demands to use a particular radio frequency, avoiding unnecessary over-regulation.

7.7.1 The Use of Spectrum by Short Range Devices (SRD) in Ireland

A complete list of permitted short range devices permitted in Ireland is contained in ODTR Document 00/62R 'Licensing Requirements for Radio

[73] Source: ODTR Document No. 02/19

Services, A Summary – 2nd Edition' published in March 2002. Within Ireland, short-range devices may be operated, within the confines of the following technical parameters, without the requirement for an individual licence.

The general terms of use are that:

a. SRDs in general operate in shared bands and are not permitted to cause harmful interference to other radio services;
b. in general SRDs cannot claim protection from other radio services;
c. due to the increasing interest in the use of SRDs for a growing number of applications it is necessary to harmonise frequencies and regulations for these devices;
d. there is a need to distinguish between different applications;
e. additional applications and associated annexes will be added as necessary.

SRDs use either integral, dedicated or external antennae and all modes of modulation can be permitted subject to relevant standards. SRDs cover a large range of different services, including Telecommand and Telecontrol, Telemetry, Alarms and Speech/Video equipment. Cordless telephones, baby monitors, wireless microphones and radio LANs are also included as short range devices.

In order to harmonise the spectrum used by short range devices in Europe the CEPT has to-date adopted eighteen Decisions[74] concerning the various frequency bands for low power devices, and specific short range devices. The Decisions describe the requirements for SRDs relating to allocated frequency bands, maximum power levels, equipment antenna, channel spacing, duty cycle, licensing, conformity assessment, marking and free circulation requirements. Much of the equipment covered would come within the ambit of the R&TTE Directive. The European Telecommunications Standards Institute (ETSI) has also developed standards for the majority of these devices.

[74] ERC Decisions (01)01 to (01)18

7.7.2 New Developments in SRD

The following proposals are being monitored by the ODTR:

a. the development of a European strategic plan for the use of the band 862-870 MHz for Short Range Devices in future;
b. a European strategic plan for the use of frequency spectrum within the band 2400-2483.5 MHz based on the international trends and market developments. The band 2400-2483.5 MHz is currently the only world-wide harmonised band for SRD applications;
c. the ODTR has submitted a proposal to the ECC to consider the use of higher power levels for RLAN type devices in the 5.8 GHz band to facilitate wireless access applications.

The introduction of new SRDs is being monitored through ODTR participation in ECC Working Groups and the evolution of ERC Recommendation 70-03[75].

Further detailed information on SRDs can be found on the ODTR web site (www.odtr.ie) and on the ERO web site (www.ero.dk/EROWEB/SRD/) which contains information on the work of the SRD Maintenance Group.

7.7.3 Short range Device Spectrum Management Objectives:

a. permit the use of Short Range Devices (SRD) in bands allocated to low power applications wherever possible, having regard to the regulatory requirements for efficient spectrum usage;
b. monitor market interest in the development of SRD;
c. contribute to the work of the CEPT, in association with industry, in developing harmonised bands for low power applications.

7.8 RECENT DEVELOPMENTS IN RADIOCOMMUNICATIONS TECHNOLOGY AND APPLICATIONS

A prominent feature of the radiocommunications sector is the extent to which it is subject to rapid technological innovation and changing market conditions. Keeping pace with these developments is one of the most difficult challenges

[75] ERC RECOMMENDATION 70-03 (Tromsø 1997 and subsequent amendments) relating to the use of short range devices (SRD) as adopted by the Frequency Management, Radio Regulatory and Spectrum Engineering Working Groups

the ODTR faces as it strives to ensure that our regulatory approaches and methods are appropriate and timely.

7.8.1 Spectrum Management Objectives on technology, market and regulatory developments:

a. contribute to the work of CEPT and the EU in seeking harmonised bands for new services;
b. anticipate technological and market developments so that we can assess and prepare for regulatory changes that may be required as a consequence;
c. develop the ODTR's Forward-looking Programme, which aims to monitor trends and developments, including those that occur within the global radiocommunications sector and identify which ones may give rise to new spectrum management issues;
d. develop new regulatory frameworks as quickly as possible to reflect developments and facilitate the introduction of appropriate technologies.

7.8.2 Ultrawideband Communications (UWB)

The term ultrawideband (UWB) communications covers short-range devices potentially capable of delivering broadband wireless communications technologies (typically in the frequency range 1 to 6 GHz) and a new generation of short range radar devices (typically around 24 GHz). Radar applications include for example level gauges in industrial process storage tanks and collision detection devices for motor vehicles[76].

Claimed advantages of this Technology

a. high transmission rates (up to 100Mbit/s) at low power spectral densities;
b. no need for exclusive or protected spectrum.

Possible disadvantages of this Technology

a. the use of a large amount of spectrum;

[76] For further details please see ODTR 01/59 – Technology Developments in Telecommunications

b. the effect of UWB systems on existing radio systems is as yet unknown, and measuring techniques have yet to be developed to successfully demonstrate the impact of UWB systems on other radiocommunication systems. Potential inference to navigation systems such as GPS has been identified as an issue which has prompted the FCC to limit UWB emissions near this part of the spectrum;
c. there are concerns that the use of a large number of such devices in a location may increase the ambient noise floor to unacceptable levels.

Licensing Issues

Due to their low power spectral density UWB systems could be treated in a similar manner to short range devices and may therefore be eligible for exemption from licensing requirements. In the case of UWB radar systems, certain restrictions on the usage methods may need to be employed (e.g. a device may only transmit when in contact with the surface being surveyed). In Ireland, and other countries, possible licensing approaches are currently under consideration.

Implications for the Irish market

If UWB is introduced to the Irish market its potential market development impact could be significant, particularly for short range wireless applications (e.g. wireless LAN) and in advanced automobile systems (e.g. short range collision detection and avoidance radar systems). Such applications could be of significant social and economic benefit. Other applications may emerge in due course and in the future UWB may offer a convenient way of overcoming some spectral resource problems. However, at present, not enough is known about its operation and the impact it will have on existing radio systems. The Spectrum Engineering Working Group of the ECC is currently undertaking a study of this technology and the ODTR is actively monitoring developments.

7.8.3 High Altitude Platform Stations (HAPS)

High Altitude Platform Stations (HAPS)[77] potentially offer a new way of delivering radiocommunication services that could help ease some of the roll out and capacity problems faced by today's telecommunications network

[77] A high altitude platform station is defined in the ITU Radio Regulations as a station located on an object at an altitude of 20 to 50 km and at a specified, nominal, fixed point relative to the Earth.

operators within the next five years. These systems overcome the need for the roll out of extensive access and back-haul networks by providing an airborne repeater station with a large coverage area. Furthermore, HAPS systems can provide instant coverage once launched without the need for expensive launch vehicles as in satellite systems[78]. HAPS may be realised in numerous ways, for example using balloon or aircraft technology.

Possible applications:

a. Mobile –HAPS for IMT-2000 (3G) applications;
b. Fixed Wireless Access – broadband access, up to 155Mbit/s or higher;
c. low cost telecommunications for developing countries;
d. broadcast services – metropolitan or region wide coverage;
e. disaster relief – rapid deployment of communications for relief workers where existing telecommunications infrastructure may be insufficient or inoperable;
f. earth sciences – inexpensive environmental studies (e.g. crop densities, radiation detection, road traffic patterns).

Advantages

a. coverage: at an altitude of 21km a HAPS could potentially achieve a coverage area of 19,000 square km which represents a circular region of 160km in diameter;
b. direct line of sight from most city streets and from any roof top to the HAPS;
c. network roll-out speed;
d. capacity, provisioning of more focused beams which aids frequency re-use;
e. accessible for maintenance and upgrades.

Disadvantages

a. complexity of aligning multiple antennae to provide the cellular reuse pattern required to deliver high capacity services;
b. potential stabilisation problems facing platforms operating in conditions of high wind and associated tethering problems.

[78] For further details please see document ODTR 01/59 – Technology Developments in Telecommunications

Frequency allocations for HAPS were made at WRC-97 and WRC-2000, and the issue will be raised again at the next World Radiocommunication Conference in 2003, WRC-03. It has also been suggested (by Japan) that HAPS could operate at practically any frequency shared with terrestrial services (fixed and mobile) above 3 GHz. The possibility of interference with amateur services in an adjacent band at 48GHz has also been raised along with possible negative implications to radio astronomy services. Sharing studies are being conducted in these areas.

Implications for Ireland

For a country the size of Ireland HAPS systems could provide region-wide coverage of broadband access services (say up to 155Mbit/s) once the technology has matured sufficiently and assuming that a sufficient degree of geographical reuse can be achieved. HAPS could also assist with the roll out of FWA and mobile services, for example by providing infrastructure links to remote base stations. The ECC is working toward preparing a common European Proposal on HAPS services for consideration at the next World Radiocommunication Conference.

7.8.4 Broadband VSAT (Very Small Aperture Terminals)

A VSAT (Very Small Aperture Terminal[79]) is a communications terminal that can be easily installed on the roof or side of a user's premises and used to access a wide range of telecommunications services such as video-on-demand and internet access. VSATs communicate through orbiting satellites, relaying information to and from controlling gateway stations known as hub stations. VSATs can offer low cost, easy to install solutions for areas with limited telecommunications infrastructure (e.g. rural areas) due to the large coverage areas offered by these satellite systems, but capacity (particularly on the return path) is likely to be limited compared to terrestrial platforms[80].

[79] The term VSAT stems from the size of the satellite terminal's antenna or dish, which is generally very small relative to traditional satellite earth stations (approx. 2 metres). A VSAT however is defined by more characteristics than just antenna size, such as networking and control details.

[80] For further details please see document ODTR 01/59 – Technology Developments in Telecommunications

Advantages

a. easy deployment;
b. rural deployment;
c. diversity.

Disadvantages

a. low capacity;
b. latency issues;

Spectrum Issues

Currently most VSAT services operate in the bands 10.7-11.7GHz, 12.5-12.75GHz Downlink, 14-14.5GHz Uplink. Some sections of these bands are also used for terrestrial fixed microwave links. VSAT services are expected to continue to grow in these bands for the foreseeable future. Other VSAT systems are planned for the bands 17.7 – 22.2GHz downlink, 27.5 - 31GHz uplink. There is more bandwidth available at these higher frequencies which yield greater capacities, and it is expected that high density services such as home internet access will develop. Certain portions of spectrum in these bands are also shared with fixed links and there are European measures that allocate these bands more specifically to these two services.

Licensing in Ireland

Currently, transmitting VSAT terminals are required to hold a Wireless Telegraphy licence while receive-only VSATs are exempt from licensing. Furthermore, there is an ERC decision that would allow for the exemption of transmitting VSAT terminals, operating in the exclusive part of the Ku band, which covers most of the VSATs that the ODTR currently licences. VSAT systems that provide services to the public may also be subject to telecommunications service licensing.

Next generation VSATs such as SITs (Satellite Interactive Terminals) and SUTs (Satellite User Terminals) operating at higher frequencies in the Ka band are also covered under the current regime. However ERC Decisions ERC/DEC (00)03 and ERC/DEC (00)04 exempt SITs and SUTs operating at powers of no more than 50dBW from licensing. These ECC decisions are being considered

for adoption in Ireland along with ERC/DEC (00)05 which provides for VSAT terminal exemption.

7.8.5 Power Line Communications[81] (PLC)

Power Line Communications is the transmission of voice, data and video via electrical power distribution lines. One application involves using the electricity power grid as a data highway and a second significant application lies in the fact that it can be used as a home network, where a person uses his/her own domestic wiring as a LAN (Local Area Network) without additional cabling.

Regulatory perspective of PLC systems: EMC and interference considerations

As electricity cables were never designed for communication purposes the technology used needs to ensure that radiation is minimised and does not cause interference to radio services. Some proposed systems apply spread spectrum technology so that the unavoidable radiation is delivered in the form of wideband low level noise thus avoiding bands which are used locally for radio services. From a regulatory perspective such PLC systems are installations covered by the EMC Directive[82]. Where the installation is in the user premises it might be designated as a terminal under the R&TTE Directive, but this will not change the requirement it has to meet in avoiding interference. Such PLC systems do not require a frequency licence as long as they can ensure that radio services do not suffer interference. This position is expected to change under the Authorisation Directive.

During recent ECC meetings many European administrations expressed serious doubts about the possibility of allocating spectrum to PLC applications. This is due to the fact that based on the current regulations and definitions in the Radio Regulations PLC applications cannot generally be considered as a radio service.

[81] Also known as PLT – Power Line Telecommunications

[82] European Council Directive of 3 May 1989 on the approximation of the laws of the Member States relating to electromagnetic compatibility
(89/336/EEC)

Studies on potential interference

A number of studies are ongoing in several countries and in CEPT ECC project teams, in which the ODTR participates, to assess the interference potential of PLC. Standardisation work is on-going in ETSI and CENELEC to perform compatibility studies with the aim of deriving limiting values for emissions from PLC and cable transmissions in order to protect radio services.

Impact of Regulation on New Services

The innovative and future services discussed in this section bring with them new demands on spectrum management. It is recognised that as the development of new technology speeds up, driven by increased demand from the market, the process of standardisation and evolving regulation to cope with new technologies must keep pace.

It is crucial that the regulator be proactive in identifying new technologies and preparing the regulatory structures to implement innovative systems as easily as possible, bearing in mind the need to balance the use of the spectrum in the national interest. The ODTR's Forward-looking Programme is dedicated to looking typically two to five years ahead in order to keep abreast of developments in technology. This initiative continues to provide relevant information and discussion on new technology and applications that affect the work of the Office.

New techniques of dynamic frequency assignment and dynamic frequency selection, combined with software defined radio structures, offer the spectrum manger enormous advantages that can be used to good affect in increasing the usage of spectrum in already congested bands. International studies and developments are being monitored in order to keep abreast of the latest developments and how they may apply to the local situation.

7.9 MILITARY USE OF SPECTRUM

7.9.1 Overview of the Defence Sector

The Defence Forces has actively utilised radiocommunications from the earliest days and the use of radio spectrum is considered critical to national security. The significance of military radio communications is reflected in the ITU Constitution and the Radio Regulations. There are no specific service allocations for defence applications in the Radio Regulations as defence communications are recognised as the prerogative of each Sovereign State.

In Europe there is increasing pressure on all elements of spectrum use including civil and military spectrum and the consequent need for greater sharing between civil and military applications. Additionally the increased involvement of national defence forces in combined international aid operations requires compatibility of communications between units.

The Act establishing the ODTR[83] requires the Director to *'publish a plan to be known as a "Radio Frequency Plan" comprised of a set of tables indicating frequency allocations in the radio spectrum.*' The 1926 WT Act provides that the section on the requirement to hold a WT licence that '*This section shall not apply to any apparatus for wireless telegraphy kept by or in the possession of the Minister for Defence for the purpose of the defence forces, nor to any ship of war belonging to the Government of Saorstat Eireann or any other country or state'*. Accordingly while the ODTR is responsible for the general management of the spectrum and overall allocations, the Defence Forces may operate equipment without a licence.

7.9.2 Use of Spectrum by the Defence Sector in Ireland

In some cases defence and civilian systems share frequency bands, while in other cases there is almost exclusive defence use of bands and in these, no civilian equipment has been manufactured for those frequency ranges. Defence Forces' communications use the aeronautical, maritime and land mobile bands as well as some of the fixed service and satellite service bands. In addition use

[83] No. 34/1996: Telecommunications (Miscellaneous Provisions) Act, 1996.

is made of various allocations for radiodetermination purposes (i.e. radionavigation and radiolocation).

7.9.3 Spectrum Management Objectives and Spectrum Strategy Issues

As indicated above there is no specific legislative regime for the licensing of military installations.

The ODTR maintains awareness of international developments, particularly in CEPT through the ECC WGFM Civil - Military forum and in liaison with the Defence Forces.

7.10 AVIATION AND MARITIME

The International Radiotelegraph Union was set up in 1906 to regulate the operation of radio services between ships and shore stations. When the ITU was founded in 1932 it took over this function from the previous body. The maritime sector has actively participated in the radiocommunication field and their requirement for access to spectrum on a global basis has been recognised by the ITU through the inclusion in the Radio Regulation of specific allocations for maritime purposes. In 1932 the ITU recognised that the aeronautical sector had similar needs and included specific allocations for aeronautical purposes in the table of frequency allocations. These allocations, for both aeronautical and maritime purposes, have been updated on a regular basis over the years.

In addition to making special provisions within the international table of frequency allocations[84] the ITU Radio Regulations also includes extensive requirements relating specifically to the maritime service or the aeronautical service, or both. The maritime and aeronautical services are the only services with which the ITU has a significant operational involvement.

In examining spectrum for both the maritime and aeronautical sectors it is important to note that in addition to the allocations for communications

[84] Article S5 of the ITU Radio Regulations

purposes, allocations for radiodetermination purposes (i.e. radionavigation and radiolocation)[85] have also been made by the ITU.

7.10.1 Overview of the Aeronautical Sector

The demand for radio spectrum by the aeronautical services is increasing. This is particularly so in the VHF communications band where in parts of Europe, due to congestion, a change in the channel spacing from 25 kHz to 8.33 kHz is being progressively implemented. The use of both terrestrial and satellite are also being considered in addition to the normal voice communications data applications. Ireland is a major user of the aeronautical HF band for communications due to its strategic location and responsibility for communications in the North Atlantic (*Shanwick*) control area.

7.10.2 Use of spectrum by the aviation sector in Ireland

The various bands available to the maritime and aeronautical services are listed in the National Table of Frequency Allocations[86] .

7.10.3 Spectrum Management Objectives for the aviation sector:

a. continue to provide protection for those aeronautical services which are considered as safety services;
b. continue close co-operation with the Irish Aviation Authority;
c. continue to provide spectrum for use by new emerging Aeronautical systems.

7.10.4 Aviation Spectrum Strategy Issues

As the aeronautical service is global in nature, changes to the spectrum allocations and assignments are often decided at the international level. These allocations and assignments are in turn implemented by the national aviation organisations.

[85] Dealt with under section 2.12
[86] See ODTR 01/23 – Table of Frequency Allocations for Ireland available on www.odtr.ie

7.10.5 Overview of the Maritime Sector

A large part of the radio spectrum below 150 kHz is allocated to the maritime services and communication over long distances can be achieved in this frequency range. However this use is small and declining. The use of the spectrum between 1600 kHz and 4000 kHz is suitable for many kinds of medium distance narrow-band services due to the propagation characteristics. Despite having to share this spectrum in some sea areas with other services on land, the maritime services make substantial use of this frequency range for distances up to a few hundred kilometres.

A number of frequency bands between 4000 kHz and 30 MHz are allocated exclusively world-wide to the maritime services, divided into use for ship stations and coastal stations with an internationally agreed frequency allotment plan. The use of the radio spectrum by the maritime sector, like that for the aeronautical sector, has to be considered at both a national and an international level. Within the maritime sector considerable emphasis is put on safety of life and there are internationally recognised channels used for distress purposes which are to be kept interference free. In this regard frequencies for the Global Maritime Distress and Safety System (GMDSS) are particularly important.

7.10.6 Use of spectrum by the Maritime sector in Ireland

The various bands allocated to the maritime and aeronautical services are listed in the Table of Frequency Allocation, Ireland.

7.10.7 Marine Spectrum Management Objectives:

a. continue to provide protection for those maritime services which are considered as safety services;
b. continue to promote the use of spectrum efficient technologies, thereby maximising the spectrum available for Maritime use;
c. continue to provide spectrum for use by new emerging Maritime systems;
d. transfer the function of ships radio licensing to the Department of the Marine.

7.10.8 Marine Spectrum Strategy Issues

As the maritime service is global in nature, changes to the spectrum allocations and assignments are decided at the international level. These plans are in turn implemented by the Department of the Marine and the Marine Radio Affairs Unit.

7.11 EXPERIMENTERS (AMATEUR RADIO)

7.11.1 Overview of Amateur Radio[87]

The Amateur Radio sector is specifically recognised by the ITU with a formal service definition in the Radio Regulations and specific spectrum allocated to it within the International Table of Frequency Allocations where it is defined as *'A radiocommunication service for the purpose of self-training, intercommunication and technical investigations carried out by amateurs, that is, by duly authorised persons interested in radio technique solely with a personal aim and without pecuniary interest'*.

Radio amateurs have used spectrum since the earliest days of radio communications and experimentation by radio amateurs continues to contribute to the development of radiocommunications service and use of the frequency spectrum. In more recent times the amateur community developed the concept of small low earth orbit satellites with a store and forward operating mode and showed the suitability of small satellites for certain applications. These concepts are now being commercially exploited and the satellites are often referred to as "micro satellites" or "micro sats". Amateurs also contribute to propagation studies either on their own or in assisting research establishments. Operating in small groups, amateurs have shown the possibilities of propagation over increasing distances using frequencies above 30 GHz.

7.11.2 Use of Spectrum by the Amateur Sector in Ireland

The Amateur service has allocations throughout the radio frequency spectrum. Some of the bands are allocated on a primary basis while other bands are

[87] Within this document reference to the Amateur Service should, unless indicated otherwise, be regarded as including the Amateur Satellite Service.

allocated on a secondary basis. Exact frequency allocations can be found in the National Table of Frequency Allocations[88].

7.11.3 Experimenter Spectrum management Objectives

a. where possible and where not required for other services the ODTR will endeavour to support the requirements of the amateur radio sector.

7.11.4 Experimenter Spectrum Strategy Issues

Summarised in the table below are the main spectrum strategy issues concerning experimenters:

Frequency Band	Current Use	Planned/Future Use for the Amateur Services
135.7 to 137 kHz	Maritime Mobile and Fixed Service	Include amateurs on secondary basis as per ERC REC 62-01 E[89]
50 – 52.0 MHz	Broadcasting in Band I - phased out	Has been added to the NTFA[90]
24.05-24.25 GHz, 47 – 47.2 GHz, 76 – 81 GHz, 122.25 – 123 GHz, 134 – 141 GHz and 241 – 250 GHz:	Not Currently used	May be allocated in line with the ITU and European Table of Common Allocations.

If other users do not emerge and if there is sufficient interest in the bands above 20GHz, the ODTR will consider allocating these segments to the Amateur Radio Service in line with the European Common Allocation Table.

[88] See ODTR 01/23 – National Table of Frequency Allocations for Ireland

[89] ERC Recommendation 62-01 E89 (Mainz 1997), recommends that the band 135.7-137.8 kHz may be used with a maximum e.r.p. of 1 Watt on a secondary basis by the Amateur Service in CEPT countries. Available as REC6201E.pdf (Use of the band 135.7-137.8 kHz by the Amateur Service) under documentation section of http://www.ero.dk/.

[90] NTFA = National Table of Frequency Allocations

7.12 MISCELLANEOUS SERVICES

7.12.1 Use of Spectrum by Citizens Band (CB) Radio in Ireland

The regulations relating to CB vary from country to country within Europe where the service is also known as "Personal Radio Communications (PR) 27". In general it is a minimally regulated service, intended to provide a two-way, short range radio service for business and personal use. Depending on the local terrain transmissions can cover distances of up to 20 kilometres and during periods of anomalous propagation PR 27 may be able to communicate over distances of hundreds of kilometres. CEPT and ETSI have undertaken considerable work to develop a European-wide common frequency band and standard. The frequency range for PR 27 is 26.96 to 27.41 MHz and in 1998 the Director exempted CB from licensing (SI No. 436 of 1998). CB equipment operating in any other frequency band may not be used in Ireland.

7.12.2 Use of Spectrum by Industrial, Scientific and Medical (ISM) applications in Ireland

The ITU Radio Regulations define the Industrial, Scientific and Medical service as: *"Operation of equipment or appliances designed to generate and use locally radio frequency energy for industrial, scientific, medical, domestic or similar purposes, excluding applications in the field of telecommunications."*

In addition to radiocommunication services which depend on their functioning on the radiation of radio frequency (RF) energy and its reception at a distance, there are other applications for RF energy that do not involve deliberate radiation outside the limits of the apparatus in which it is used. The most important of these involve industrial, scientific or medical (ISM) apparatus, a category which includes domestic and commercial microwave ovens. A considerable amount of RF energy may be radiated unintentionally from such installations, capable of causing severe interference to local receivers. A number of frequency bands as summarised in the table below have been

designated for use by ISM apparatus and further details can be found in the National Table of Frequency Allocations[91].

ISM Frequency Bands	Centre Frequency of Band
6 765-6 795 kHz	6 780 kHz
13 553-13 567 kHz	13 560 kHz
26 957-27 283 kHz	27 120 kHz
40.66-40.70 MHz	40.68 MHz
433.05-434.79 MHz	433.92 MHz
2 400-2 500 MHz	2 450 MHz
5 725-5 875 MHz	5 800 MHz
24-24.25 GHz	24.125 GHz
61-61.5 GHz	61.25 GHz
122-123 GHz	122.5 GHz
244-246 GHz	245 GHz

While the same bands have been allocated to other services, devices sharing the band with ISM applications must tolerate interference from ISM apparatus.

7.12.3 Use of Spectrum by Cordless Telephones in Ireland

The following types of cordless phones may be used in Ireland:

a. analogue (31.025 -31.325 MHz and 39.925 – 40.255 MHz);
b. digital (CT2 in 864.1 – 868.1 MHz);
c. Digital Enhanced Cordless Telecommunications (DECT, 1710-1785 / 1805-1880 MHz).

These devices have been licence exempt for a number of years and freely available. Cordless phones operating in any other frequency band may not be used in Ireland. There are moves within Europe to phase out the use of CT2 technology. The ODTR is carefully considering a recent ECC Decision[92]

[91] Document ODTR 01/23.
[92] ECC Decision ECC/DEC/(01)02 on 'Phasing out digital CT2 applications in the 900 MHz band

which intends to complete the phasing out of these services by 2005 and will consider any notice of interest in the use of CT2 technology.

7.12.4 Spectrum Management Objectives for these Miscellaneous Services:

a. consider, after consultation, the implications of a recent CEPT Decision[93] to phase out CT2 cordless telephone services in the 900 MHz band by 2005.

7.13 SCIENCE SERVICES

7.13.1 Overview of Science Services

The science services use the radio spectrum for a range of applications, for example, observations of our natural environment made by sensors that function at frequencies set aside for the purpose. These sensors may be passive or active. Passive sensors take the form of sensitive radiometers which measure the strength of the natural radiation within chosen frequency limits radiating, for example, from the surface of the earth or from within its atmosphere. Active sensors are essentially radar which analyse radiation returned from a target that has been illuminated by transmissions from the sensor.

Many of the activities of the space research, Earth exploration-satellite and the meteorological-satellite services are of this kind, using passive or active sensors carried by satellites in Earth orbit. A special case is the radio astronomy service, which observes emissions of natural origin arriving from beyond the Earth's atmosphere. All radio astronomy allocations are used passively.

There are three other science-related radio services. The meteorological aids service, which is used for links to platforms, airborne or seaborne, which gather meteorological data. The standard frequency and time signal service and the corresponding standard frequency and time signal-satellite service which is

[93] ECC Decision (01)2 on phasing out digital CT2 applications in the 900 MHz band

used for comparison of time and frequency standards and the dissemination of these standards.

7.13.2 Science Service Spectrum Management Objectives:

a. liaise with Met Éireann and other scientific organisations to ensure that current and future spectrum requirements of the Science Services are fully understood and, wherever possible, incorporated into national plans for future spectrum planning conferences;
b. remain appraised of possible means of reducing unwanted emissions to protect Radioastronomy and other passive services;
c. protect national Science Service interests in national and international fora.

7.13.3 Meteorology/Earth Exploration

Meteorology depends on radio both to collect the data upon which its predictions are based and to disseminate to the public and specialised users the weather information and warnings which results. The dissemination of weather information to the public and specialised users uses the normal communications channels such as broadcasting, telephony or aviation/maritime radio.

It is in the collection of data that meteorology has special requirements. This includes weather satellites, storm tracking, sea surface temperature and wave height measurements etc. In recent years the science of using satellites for remote earth-sensing for environmental and other purposes has developed. Active sensing involves both the transmission and reception of a signal. Its uses are many and varied from measuring the characteristics of sea surface to determining the density of trees in a rain forest.

7.13.4 Meteorological Service Spectrum Strategy Issues

a. the ODTR will continue to offer a high degree of protection to meteorological services, in view of their use in the safeguarding of human life and property;

b. the ODTR will continue to offer a high degree of protection to Earth-exploration services in view of the potential impact of interference on passive and active sensors which could severely disrupt scientific research programmes.

7.13.5 Radio Astronomy

Radio astronomy is defined in the Radio Regulations as*: "Astronomy based on the reception of radio waves of cosmic origin"*. To date, Ireland does not have any radio astronomy installations. However, interest has recently been expressed in the establishment of a radio astronomy observatory in the State. As radio astronomy is a receive-only service, which attempts to receive very weak signals, it is particularly vulnerable to interference. Throughout the ITU table of allocations certain bands are allocated to radio astronomy and administrations are urged to take all practicable steps to protect the radio astronomy service from harmful interference. In a number of the bands all emissions by other services are prohibited. However with the demand for spectrum by telecommunications services the spectrum previously available to radio astronomy and the level of protection afforded is constantly coming under threat.

7.13.6 Radio Astronomy Spectrum Strategy Issues

The ODTR has taken an active interest in the establishment of a radio astronomy observatory in Ireland and will endeavour to protect such a site using internationally accepted procedures and techniques to mitigate and prevent interference in the frequency bands of interest.

7.13.7 Standard Frequency and Time Signal Service

The Radio Regulations define the standard frequency and time signal service as*: 'A radiocommunication service for scientific, technical and other purposes, providing the transmission of specified frequencies, time signals, or both, of stated high precision, intended for general reception'* and the standard frequency and time signal-satellite service is defined as: *'A radiocommunication service using space stations on earth satellites for the same purposes as those of the standard frequency and time signal service'*.

There are no standard frequency and time installations in Ireland. The terrestrial systems use frequencies in the short wave and long wave bands and signals from major installations such as MSF Rugby (in the UK) and Darmstadt (in Germany) operating in the LF band, are readily received and used in Ireland. In recent times the interconnecting of telecommunication networks is dependent on the networks being synchronised to a very high degree and the standard time signal provides an accurate reference signal for this purpose. Standard frequency signals are generally used in the calibration and checking of electronic equipment.

More recently, satellite-based standard frequency and time signals have become available using very high accuracy atomic clocks on board each orbiting satellite that are constantly monitored by a control centre on the ground. The most well known is the Global Positioning System (GPS) operated by the United States Department of Defence. The European Union is developing a satellite radionavigation system called Galileo, Europe's contribution to the next-generation of global navigation satellite services. The project is designed to introduce greater safety in air traffic management and air navigation, as well as better train safety control, road traffic management and other surface transport applications by developing and deploying up to 30 earth orbit satellites.

7.13.8 Frequency and Time Spectrum Strategy Issues

The ODTR will continue to offer a high degree of protection to time and frequency services, in view of their use in the safeguarding of human life and property.

7.14 RADIODETERMINATION

7.14.1 Overview of Radiodetermination Services

The Radio Regulations define the Radiodetermination service as: '*the determination of the position, velocity and/or other characteristics of an object, or the obtaining of information relating to these parameters, by means of the propagation properties of radio waves'*.

Radiodetermination comprises both radionavigation and radiolocation systems that are used for the navigation of ships, aircraft and vehicles, for example, radar systems. These systems provide safety services that, by definition, involve the safeguarding of human life and property and are therefore given a high degree of protection from interference. In addition to the terrestrial radionavigation services, which are subdivided between the maritime and aeronautical radionavigation services, there are the radionavigation-satellite and radiolocation-satellite services. The radionavigation satellite service is further sub-divided into maritime and aeronautical services.

The Commissioner of Irish Lights operates and maintains a number of maritime radionavigation aids including differential GPS stations on a trial public basis and Racons (Radar Beacons).

Similarly the Irish Aviation Authority operates and maintains a number of aeronautical radionavigation aids including Non Directional Radio Beacons and Distance Measuring Equipment.

7.14.2 Radiodetermination Service Spectrum Management Objectives:

a. promote and protect national radiodetermination service interests in national and international fora;
b. remain appraised of possible means of reducing unwanted emissions to protect the radiodetermination services.

7.14.3 Spectrum Strategy Issues

The ODTR will continue to offer a high degree of protection to all radiodetermination services, in view of their use in the safeguarding of human life and property.

Part D:

APPENDIX A – Review of Responses to Draft Spectrum Strategy

A.1. LIST OF RESPONDENTS

Eleven responses were received on the August 2001 draft spectrum strategy document. The respondents included telecommunication operators, lobby groups, consultants, industry forums and interested parties as listed below in alphabetical order:

- Cork Wan
- Damien Mulley
- Digifone
- eircom Plc
- Ericsson Ireland
- ESB Telecoms
- Eutelsat
- Fort Corbenic Corp
- Global VSAT Forum
- It's TV Limited
- Visitor Based Networks

The Director wishes to express her thanks to everyone who contributed comments. With the exception of material marked confidential, the written comments of respondents are available for inspection at the ODTR office in Dublin.

A.2. RESPONSES ON PART A: THE DEVELOPMENT OF A STRATEGIC FRAMEWORK FOR RADIO SPECTRUM MANAGEMENT.

Part A of the draft spectrum strategy looked at the economic impact of spectrum, market development and the need for radio spectrum management, broad spectrum management objectives adopted by the ODTR, the issue of

administrative pricing and developments in key services all of which have aided the development of the strategic framework.

A.2.1 Views of the Respondents

One respondent drew the attention of the ODTR to the requirement of a strategic guideline ensuring spectrum and protection for essential services and emergency services. The Director agrees that the provision of spectrum and protection of emergency services is an important guideline but disagrees that essential services generally should be accorded the same status. Hence an additional strategy guideline has been added to the document in order to continue the provision and protection of spectrum for public safety, emergency services and safety of life services in view of their vital role in the safeguarding of human life and property.

A number of respondents commented on the section relating to Administrative Pricing in Ireland. This issue is also discussed in the response to the consultation on radio spectrum management[94] which the ODTR published in May 2001. It was noted that congestion is not a serious problem in most geographical areas in Ireland but where it does occur administrative pricing can be an effective tool to alleviate congestion, encouraging the use of alternative frequency bands and technologies. It may be inappropriate in some instances to charge the same spectrum fee across the country and Section 5.6 in this document has been amended to note a range of factors that could be taken into account in an administrative pricing process such as location, channel loading and use of innovative technology. Pricing would also take into account factors such as congestion in specific bands or geographic areas and the degree of exclusivity of spectrum assignments. The Director intends to issue a consultation paper by Autumn, 2002.

One respondent felt that it would be useful to have the National Table of Frequency Allocations incorporated into the spectrum strategy document and this was the original intention. However it was decided to maintain the two as separate documents in order to update them separately. The National Table of

[94] Document Number ODTR 01/31

Frequency Allocations is available on the ODTR website and in bound printed form on request.

A.3. RESPONSES ON PART B: THE RADIO SPECTRUM MANAGEMENT FRAMEWORK.

Part B of the draft spectrum strategy set out the global, European and national framework in which spectrum management occurs. In addition the radio equipment standardisation framework, non ionising radiation and the issue of mast sites were addressed in this section.

A.3.1 Views of the Respondents

A respondent on this section declared an interest in information relating to international developments and a communication process permitting timely debate. One of the Director's reasons for developing and publishing this paper is to provide information to spectrum users on trends and developments at a European and international level. The ODTR will continue to consult on issues as they arise and as necessary.

A.4. RESPONSES ON PART C: STRATEGIC DEVELOPMENTS IN RADIO SERVICES.

Part C of the draft spectrum strategy focused on the services using radio spectrum giving an overview of the service, specific spectrum management objectives for the service and where applicable particular spectrum strategy issues that have been identified for action. As expected this section drew the most comment, although limited to each respondent's particular field of interest.

A.4.1 Views of the Respondents on Mobile Cellular Services

It was noted by a respondent that the ODTR approach of setting out different management objectives for each of the different platform-specific technologies and services is not technology-neutral and at odds with the new EU regulatory

framework. The Director agrees and supports a technology-neutral approach, and notes that general criteria have been set out for all services. However, there are different issues affecting different types of technology, for example, sharing and compatibility between wireless access services and satellite communication services in the same bands, and these do need to be addressed so that they can all contribute effectively to the delivery of high quality telecoms services. Despite the trend toward convergence it is likely to be some time before regulations can adopt a wholly technologically-neutral approach.

One respondent queried spectrum availability for 2.5G services should operators go down the road of establishing separate radio plans for GPRS networks. In this regard, spectrum is available for expansion of GSM services if the demand can be justified and the currently allocated spectrum can be shown to be effectively utilised.

A respondent questioned the ODTR's objective to improve the quality of service by way of regular quality of service audits. The ODTR is concerned by the number of complaints received concerning the 'poor' quality of service offered by licence holders. To ensure that at least the minimum requirements as stipulated in the licence conditions of each operator are being achieved, regular audits are planned.

A.4.2 Views of the Respondents on Fixed Services

Respondents questioned the ODTR strategy on dealing with what is envisaged to be a high demand for fixed links in support of 3G networks. In addition, concern was raised on the manner in which the ODTR proposes to migrate existing users in the fixed service bands. The Director intends to review the use of the fixed service spectrum during 2002.

A.4.3 Views of the Respondents on Broadcasting

A few respondents commented on the allocation of the band presently used for MMDS as an expansion band, within Europe, for 3G services. Granted, while

this is not a priority at present, there may be a problem with 3G expansion in the future. Bearing in mind that the MMDS services are well established in this band and currently hold licences until 2015, the Director has initiated a study into a long term strategy to deal with the future of both the MMDS service and the 2500-2690 MHz band.

A.4.4 Views of the Respondents on Business Radio

A respondent expressed concern at the implications that current plans in the UK to align the UHF business radio band with the European bandplan would have on systems within Ireland. The Director understands this concern and the ODTR is monitoring the situation and will convene a timely consultation process with the industry in order to reach consensus on the appropriate measures to be taken.

A.4.5 Views of the Respondents on Satellite Communications

A strong lobby was received from the satellite industry for Ireland to commit to a number of ERC Decisions involving VSAT, satellite user terminals, satellite interactive terminals, sharing of the band 10.7-12.5GHz, 17.7-19.7 GHz and the band 27.5-29.5 GHz. The Director has noted the concerns of the satellite broadcast industry and the position of the Director on the sharing of the 10.7-12.5 GHz band has been covered in the consultation and response to the consultation on 'Licensing Regional or Locally Based Digital Television Delivery'[95]. Concerning the other issues the ODTR is investigating the practicalities of each Decision, while taking into account the needs of other users, with a view to establishing a suitable regulatory regime to deal with these new fixed-satellite services.

A.4.6 Views of the Respondents on Short Range Devices

A number of respondents raised the issue of the use of short range devices in the 2.4 GHz and 5 GHZ frequency bands. Of primary concern was that the

[95] Document ODTR 01/69 and ODTR 01/97.

present standards permitted do not include the popular 802.11a standard and that in other than densely populated areas, the permitted output power was not sufficient to develop a comprehensive business plan. The frequency bands concerned are shared with other services which constrain the use of wireless access and other short range devices in these bands. Further details are given in the Briefing Note on Wireless Local Area Networks published in January 2002. The ODTR has just completed a consultation[96] in which the Director is proposing to permit the deployment of higher power fixed access systems in the 5.725 – 5.875 GHz frequency band.

[96] Document ODTR 02/19 - Expanding Opportunities in the Radiocommunications Market: Fixed Wireless Access (FWA)

APPENDIX B - ODTR Contact Points

Queries relating to Spectrum Management should in the first instance be addressed to:

Mr. Jim Connolly
Senior Manger
Spectrum Management, Competitions & International Strategy
ODTR,
Abbey Court,
Irish Life Centre,
Lower Abbey Street,
Dublin 1.

General queries regarding radio or licensing matters can be directed to:

The Office of the Director of Telecommunications Regulation,
Abbey Court,
Irish Life Centre,
Lower Abbey Street,
Dublin 1.

Tel: 01 804 9600
Fax: 01 804 9680

Email: info@odtr.ie

Internet Site

The ODTR maintains a comprehensive and regularly updated Web Site at: http://www.odtr.ie

Publications

This document is available in electronic format from the ODTR web site at: http://www.odtr.ie

The National Table of Frequency Allocations is available electronically from the ODTR web site at: http://www.odtr.ie or by writing to Mr. Samuel Ritchie, ODTR, Abbey Court, Irish life Centre, Lower Abbey Street, Dublin 1.

Sources of Further Information

The International Telecommunications Union

This organisation is responsible for the publication of the Radio Regulations which includes the International Table of Frequency Allocations. The Radio Regulations also detail the footnotes, appendices and describe the different categories of service referred to in the Table of Frequency Allocations, Ireland.

Publications of the International Telecommunications Union (ITU) can be obtained from:

Sales and Marketing Service,
International Telecommunications Union,
Place Des Nations, Ch-1211,
Geneva 20,
Switzerland.

Tel: +41 22 730 61 41
Fax: +41 22 730 51 94
Email: sales@itu.ch

Web Site: http://www.itu.int

CEPT Documentation, including ERC and ECC Decisions, Recommendations, Reports and Publications of the European Radiocommunications Office (ERO) can be obtained from:

The European Radiocommunications Office,
Peblingehus
Nansensgade 19
DK 1366 Copenhagen
Denmark

Tel: +45 33 89 63 00
Fax: +45 33 89 63 30
E-mail: ero@ero.dk
Web Site: http://www.ero.dk

Publications of the European Telecommunications Standards Institute (ETSI) can be obtained from:

The Sales Office,
ETSI,
Sofia Antipolis,
Nice,
France
Tel: +33 92 94 42 41
Fax: +33 93 95 81 33
Email: secretariat@etsi.fr
Web Site: http://www.etsi.org/

Irish Equipment Standards (Including ETSI transposed standards) can be obtained from the National Standards Authority of Ireland at the address below:

Sales Office,
NSAI, Glasnevin,
Dublin 9,

Tel: 01 807 3877
Fax: 01 807 3841

Irish Government Publications, including Statutory Instruments, can be obtained from:

The Government Publications Office,
4/5 Harcourt Road,
Dublin 2.

Tel: 01 661 3111
Fax: 01 475 2760

EC Directives and other European Community publications can be obtained from:

The European Commission Representation in Ireland,
European Union House,
18 Dawson Street,
Dublin 2.

Tel: 01 662 5113
Fax: 01 662 5118

APPENDIX C - Glossary of Terms and Definitions

Key to Abbreviations

ADSL	Asymmetric Digital Subscriber Line
AM	Amplitude Modulation
Appendix 17	Appendix 17 of the Radio Regulations: Frequencies and channelling arrangements in the high-frequency bands for the maritime mobile service
Appendix 18	Appendix 18 of the Radio Regulations: Table of transmitting frequencies in the VHF maritime mobile band
Appendix 27	Appendix 27 of the Radio Regulations: Frequency allotment plan for the aeronautical mobile (R) service and related information
Appendix 30	Appendix 30 of the Radio Regulations: Provisions for all services and associated plans for the broadcast-satellite service in the frequency bands 11.7-12.2 GHz (in Region 3), 11.7-12.5 GHz (in Region 1), and 12.2-12.7 GHz (in Region 2)
Appendix 30A	Appendix 30A of the Radio Regulations: Provisions and associated Plans and Lists 1 for feeder links for the broadcasting-satellite service (11.7-12.5 GHz in Region 1, 12.2-12.7 GHz in Region 2 and 11.7-12.2 GHz in Region 3) in the frequency bands 14.5-14.8 GHz 2 and 17.3-18.1 GHz in Regions 1 and 3, and 17.3-17.8 GHz in Region 2
AVI	Automatic Vehicle Identification
AVL	Automatic Vehicle Location
BCI	Broadcasting Commission of Ireland
BSS	Broadcasting-Satellite Service
CEN	European Committee for Standardisation
CENELEC	European Committee for Electro-technical Standardisation
CEPT	European Conference of Postal and Telecommunications Administrations
CT2	European analogue cordless telephone system (second generation) (I-ETS 300 131)
DAB	Digital Audio Broadcasting
DCS1800	Digital Communications System, 1800 MHz band, now generally referred to as GSM 1800
DECT	Digital Enhanced Cordless Telecommunications: a pan-European standard for short-range cordless telephones
DGPS	Differential Global Positioning System
DTT	Digital Terrestrial Television
DVB	Digital Video Broadcasting
Earth - space	Earth to space direction of transmission (for satellite communications)
EBU	European Broadcasting Union
EC	European Commission
ECC	Electronic Communications Committee

ECC/DEC	ECC Decision
ECC/REC/	ECC Recommendation
EESS	Earth Exploration-Satellite Service
EGSM	Extended Global System for Mobile Communications (see GSM)
EMC	Electromagnetic Compatibility
ENG/OB	Electronic News Gathering/Outside Broadcast
EPIRB	Emergency Position-Indicating Radio Beacon
ERC	European Radiocommunications Committee - A committee of CEPT responsible for radio matters, now replaced by the ECC (see above)
ERC/DEC/	ERC Decision
ERC/REC/	ERC Recommendation
ERO	European Radiocommunications Office - A permanent office within CEPT dealing with radio matters.
ERMES	European Radio Messaging System
ETACS	Extended Total Access Communications System (analogue cellular telephone system).
ETS	European Telecommunication Standard
ETSI	European Telecommunication Standards Institute
EU	European Union
FDDA	Field Disturbance and Doppler Apparatus (Motion Detectors)
FM	Frequency Modulation
FSS	Fixed-Satellite Service.
FSTV	Fast Scan Television
FWA	Fixed Wireless Access
FWPMA	Fixed Wireless Point-to-Multipoint Access
GDP	Gross Domestic Product
GHz	Gigahertz - 1,000,000,000 Hertz. (Also see Hz)
GMDSS	Global Maritime Distress and Safety System
GPS	Global Positioning System.
GSM	Global System for Mobile Communications (Public mobile cellular communication system)
GSO	Geostationary Orbit
HAPS	High Altitude Platform Station
HDFS	High Density Fixed Service
HDFSS	High Density Fixed-Satellite Service
HDTV	High Definition Television
HF	High Frequency band (3 – 30 MHz)

Hz	Hertz, The unit of frequency measurement, (1 kHz = 1000 Hz, 1 MHz = 1000,000 Hz, 1GHz = 1000,000,000 Hertz)
HIPERLAN	High Performance Radio Local Area Network
IAA	Irish Aviation Authority
ICNIRP	International Commission on Non-Ionising Radiation Protection
IMT-2000	International Mobile Telecommunications – 3rd generation Mobile Systems
INTELSAT	International Telecommunications Satellite Organisation
INMARSAT	International Maritime Satellite Organisation
ISM	Industrial, Scientific and Medical applications
ITU	International Telecommunications Union
ITU-R	Radiocommunication Sector of the ITU
ITU-S	Standardisation Sector of the ITU
ITU-T	Telecommunication Sector of the ITU
ITU Geneva 75 Plan	Plan for the assignment of frequencies to broadcasting stations in the medium frequency. bands in Regions 1 and 3 and in the low frequency bands in Region 1
ITU Geneva 84 Plan	Frequency assignment plan for FM sound broadcasting stations in Region 1 and part of Region 3 in the band 87.5-108 MHz
ITU Geneva 85 Plan	Frequency assignment plan (Region 1) for stations of the maritime mobile service in the bands 85 415-495 kHz 505-kHz 1606.5-1625 kHz 1635-1800 kHz 2045 - 2160 kHz. Frequency assignment plan (Region 1) for stations of the aeronautical radionavigation service (radiobeacons) in the band 415-435 kHz and 510-526.5 kHz. Frequency assignment plan for stations of the radionavigation service (radiobeacons) for the European Maritime Area in the band 283.5-315 kHz
ITU Stockholm 61 Plan	Plans annexed to the Regional agreement for the European Broadcasting Area concerning the use of frequencies by the broadcasting services in the VHF and UHF bands
kHz	Kilohertz - 1000 Hz. (Also see Hz)
LAN	Local Area Network
LEO	Low Earth Orbit
LPD	Low Power Device (Low power radio transmitters used for general data telemetry and telecommand). See also SRD.
LVD	Low Voltage Directive
MEO	Medium Earth Orbit
MHz	Megahertz - 1,000,000 Hz. (Also see Hz)
MMDS	Multipoint Microwave Television Distribution Systems
MRAU	Marine Radio Affairs Unit
MSS	Mobile Satellite Service
MVDS	Microwave (or Multi-point) Video Distribution System
MWS	Multimedia Wireless System

N-GSO	Non-Geostationary Orbit
NRA	National Regulatory Authority
PC	Personal Computer
PMR Band	Private Mobile Radio Band (Frequency band mainly used for business radio purposes)
RACON	Radar Beacon
RDS	Radio Data System
RLAN	Radio Local Area Network
R&TTE	Radio and Telecommunications Terminal Equipment
SAB	Services Ancillary to Broadcasting
SAR	Search and Rescue
SCADA	Supervisory, Control and Data Acquisition
S-DAB	Satellite Digital Audio Broadcasting.
SMP	Significant Market Power
SNG	Satellite News Gathering
S-PCS	Satellite Personal Communications System.
space - Earth	space to Earth direction of transmission (for satellite communications)
SHF	Super High Frequency (3000 MHz – 30 GHz)
S.I.	Statutory Instrument (National Legislation)
SRD	Short Range Devices
STL	Studio to Transmitter Link
T-DAB	Terrestrial Digital Audio Broadcasting
TACS	Total Access Communications System (Analogue cellular telephone service)
TETRA	Terrestrial Trunked Radio (Digital radio standard)
TV	Television
UHF	Ultra High Frequency (300 MHz – 3000 MHz)
UIC	Union International Chemin de Fer (International railways organisation)
UMTS	Universal Mobile Telecommunications Systems (European IMT-2000 standard).
UWB	Ultra Wide Band
VHF	Very High Frequency (30 – 300 MHz)
VHF-FM	Very High Frequency – Frequency Modulated
VSAT	Very Small Aperture Terminal
WARC	World Administrative Radio Conference
WRC	World Radiocommunication Conference

Terms and Definitions:

Administration
Any governmental department or service responsible for discharging the obligations undertaken in the Constitution of the International Telecommunication Union, in the Convention of the International Telecommunication Union and in the Administrative Regulations.

Allocation
Entry in the Table of Frequency Allocations of a given frequency band for the purpose of its use by one or more terrestrial or space radiocommunication services or the radio astronomy service under specified conditions. This term shall also be applied to the frequency band concerned.

Allotment (of a radio frequency or radio frequency channel)
Entry of a designated frequency channel in an agreed plan, adopted by a competent conference, for use by one or more administrations for a terrestrial or space radiocommunication service in one or more identified countries or geographical areas and under specified conditions.

Aeronautical Mobile Service
A mobile service between aeronautical stations and aircraft stations, or between aircraft stations, in which survival craft stations may participate; emergency position-indicating radiobeacon stations may also participate in this service on designated distress and emergency frequencies.

Aeronautical Fixed Service
A radiocommunication service between specified fixed points provided primarily for the safety of air navigation and for the regular efficient and economical operation of air transport.

Aeronautical Mobile - Satellite Service
A mobile satellite service in which mobile earth stations are located on board aircraft; survival craft stations and emergency position indicating radiobeacon stations may also participate in this service.

Amateur Service
A radiocommunication service for the purpose of self-training, intercommunication and technical investigations carried out by amateurs, i.e., by duly authorised persons interested in radio technique solely with a personal aim and without pecuniary interest.

Amateur - Satellite Service
A radiocommunication service using space stations on earth satellites for the same purposes as those of the amateur service.

Assigned Frequency
The centre of the frequency band assigned to a station.

Assigned frequency band
The frequency band within which the emission of a station is authorised; the width of the band equals the necessary bandwidth plus twice the absolute value of the frequency tolerance. Where space stations are concerned, the assigned frequency band includes twice the maximum Doppler shift that may occur in relation to any point of the Earth's surface.

Assignment (of a radio frequency or radio frequency channel)
Authorisation given by an administration for a radio station to use a radio frequency or a radio frequency channel under specified conditions.

Broadcasting Service
A radiocommunication service in which the transmissions are intended for direct reception by the general public. This service may include sound transmissions, television transmissions or other types of transmission.

Broadcasting - Satellite Service
A radiocommunication service in which signals transmitted or retransmitted by space stations are intended for direct reception by the general public. In the broadcasting satellite service the term “direct reception” shall encompass both individual reception and community reception.

Deep Space
Space at a distance from the Earth approximately equal to, or greater than, the distance between the earth and the moon.

Earth Exploration - Satellite Service
A radiocommunication service between earth stations and one or more space stations which may include links between space stations, in which:

- information relating to the characteristics of the earth and its natural phenomena is obtained from active sensors or passive sensors on earth satellites;
- similar information is collected from airborne or earth based platforms;
- such information may be distributed to earth stations within the system concerned;
- platform interrogation may be included.

This service may also include feeder links necessary for its operation.

Emergency Position - Indicating Radiobeacon Station
A station in the mobile service the emissions of which are intended to facilitate search and rescue operations.

Fixed Service
A radiocommunication service between specified fixed points.

Fixed - Satellite Service
A radiocommunication service between earth stations at specified fixed points when one or more satellites are used; in some cases this service includes satellite-to-satellite links, which may also be effected in the inter-satellite service; the fixed-satellite service may also include feeder links for other space radiocommunication services.

Galileo
A proposed European global satellite navigation system.

Harmful Interference
Interference which endangers the functioning of a radionavigation service or of other safety services or seriously degrades, obstructs, or repeatedly interrupts a radiocommunication service operating in accordance with Radio Regulations.

High Altitude Platform Station
A station located on an object at an altitude of 20 to 50 km and at a specified, nominal, fixed point relative to the Earth’s surface.

Inductive Loop Systems
Systems which operate by producing a controlled magnetic field within which a predetermined recognisable signal is formed.

Industrial, Scientific and Medical (ISM) applications (of radio frequency energy)
Operation of equipment or appliances designed to generate and use locally, radio frequency energy for industrial, scientific, medical, domestic or similar purposes, excluding applications in the field of telecommunications.

Instrument Landing System (ILS)
A radionavigation system which provides aircraft with horizontal and vertical guidance just before and during landing and, at certain fixed points, indicates the distance to the reference point of landing.

Interference
The effect of unwanted energy due to one or a combination of emissions, radiations, or inductions upon reception in a radiocommunication system, manifested by any performance degradation, misinterpretation, or loss of information which could be extracted in the absence of such unwanted energy.

Meteorological Aids Service
A radiocommunication service used for meteorological, including hydrological, observations and exploration.

Meteorological - Satellite Service
An earth exploration-satellite service for meteorological purposes.

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

Mobile - Satellite Service
A radiocommunication service between mobile earth stations and one or more space stations, or between space stations used by this service or between mobile earth stations by means of one or more space stations. This service may also include feeder links necessary for its operation.

Maritime Mobile Service
A mobile service between coast stations and ship stations, or between ship stations, or between associated on board communication stations; survival craft stations and emergency position-indicating radiobeacon stations may also participate in this service.

Maritime Mobile - Satellite Service
A mobile satellite service in which mobile earth stations are located on board ships; survival craft stations and emergency position-indicating radiobeacon stations may also participate in this service.

Primary
Where a band is indicated as allocated to more than one service and the name of the service is printed in "Capitals" (e.g. MOBILE) these are called "primary" services. Within a band, Primary services shall have prior choice of frequencies. (also see secondary services). Where a band is indicated in a footnote of frequency allocation table as allocated to a service "on a primary basis" in an area smaller than a region or in a particular country, this is a primary service in that country. (As used in the International Radio Regulations and in the National Table of Frequency Allocations).

Primary Radar
A radiodetermination system based on the comparison of reference signals with radio signals reflected from the position to be determined.

Radar
A radiodetermination system based on the comparison of reference signals with radio signals reflected, or retransmitted, from the position to be determined.

Radar Beacon (Racon)
A transmitter-receiver associated with a fixed navigational mark which, when triggered by a radar, automatically returns a distinctive signal which can appear on the display of the triggering radar, providing range, bearing and identification information.

Radio Astronomy
Astronomy based on the reception of radio waves of cosmic origin.

Radio Astronomy Service
A service involving the use of radio astronomy.

Radio Waves
Electromagnetic waves of frequencies arbitrarily lower than 3 000 GHz, propagated in space without artificial guide.

Radiocommunication
Telecommunication by means of radio waves.

Radiocommunications Service
A service involving the transmission, emission and/or reception of radio waves for specific telecommunications purposes.

Radiodetermination
The determination of the position, velocity and/or other characteristics of an object, or the obtaining of information relating to these parameters, by means of the propagation properties of radio waves.

Radionavigation
Radiodetermination used for the purposes of radionavigation, including obstruction warning.

Radiolocation
Radiodetermination used for purposes other than radionavigation.

Radiosonde
An automatic radio transmitter in the meteorological aids service usually carried on an aircraft, free balloon, kite or parachute, and which transmits meteorological data.

Safety Service
Any radiocommunication service used permanently or temporarily for the safeguarding of human life and property.

Secondary Where a band is indicated as allocated to more than one service and the name of the service is printed in normal characters (e.g. Mobile) these are called secondary services. Stations of a secondary service:

- shall not cause harmful interference to stations of primary services to which the frequencies are already assigned or to which stations may be assigned at a later date;
- cannot claim protection from harmful interference from stations of a primary service to which frequencies are already assigned or may be assigned at a later date;
- can claim protection, however, from harmful interference from stations of the same or other secondary service(s) to which frequencies may be assigned at a later date.

Where a band is indicated in a footnote of the Table [of Frequency Allocations] as allocated to a service "on a secondary basis" in an area smaller than a region or in a particular country, this is a secondary service.
(As used in the International Radio Regulations and in the National Table of Frequency Allocations).

Secondary Radar
A radiodetermination system based on the comparison of reference signals with radio signals retransmitted from the position to be determined.

Space Research Service
A radiocommunication service in which spacecraft or other objects in space are used for scientific or technological research purposes.

Spurious Emission
Emission on a frequency or frequencies which are outside the necessary bandwidth and the level of which may be reduced without affecting the corresponding transmission of information. Spurious emissions include harmonic emissions, parasitic emissions, inter-modulation products and frequency conversion products, but exclude out-of-band emissions.

Standard frequency and Time Signal Service
A radiocommunication service for scientific, technical and other purposes, providing the transmission of specified frequencies, time signals or both, of stated high precision, intended for general reception.

Standard Frequency and Time Signal - Satellite Service
A radiocommunication service using space stations on earth satellites for the same purpose as those of the standard frequency and time signal service.

Telecommunication
Any transmission, emission or reception of signs, signals, writings, images and sounds or intelligence of any nature by wire, radio, optical or other electromagnetic systems

Unwanted emission
Consists of spurious emissions and out-of-band emissions.

APPENDICES D and E

APPENDIX D – The Radio Spectrum – An Overview

Following this page is a fold-out diagrammatic representation of the electromagnetic spectrum.

The purpose of the chart is to provide a simple, high-level view of typical uses of the various frequency ranges which comprise the radio spectrum. It shows:

1. that the radio spectrum, which is regulated by the ODTR, is a small fraction of the total electromagnetic spectrum;
2. that the radio spectrum is traditionally divided into different bands, such as VLF (Very Low Frequency) and UHF (Ultra High Frequency), based on wavelengths, i.e. the shorter the wavelength the higher the frequency;
3. typical services and systems found in each of the different bands;
4. the current limit of 300GHz above which the spectrum has not yet been allocated to specific services.

Following the general overview of the radio spectrum in Appendix D there is a more detailed fold-out view of the UHF and SHF frequency bands in:

APPENDIX E – Overview of Frequency Allocation & Usage in the Range 300 MHz to 30 GHz

Note:

These charts are available as a separate appendix document call odtr0243_annex.doc and can be viewed on our website www.odtr.ie

End