ICT Regulation Toolkit / 5. Radio Spectrum Management /

Spectrum Policy and Planning

Spectrum regulators will have to make decisions about the uses of spectrum and on who should be allowed to use it (i.e., uses and users). The international framework for the utilization of the radio frequency spectrum is set out in the ITU's Radio Regulations. There is, however, considerable flexibility for the establishment of national policies following recommendations contained within the framework. The mechanism for determining who may use spectrum within a given country involves some planning. How much planning depends on the extent to which the regulator wishes to rely on the market. The greater the reliance on the market, the less planning will be required.

5.2.1 INTRODUCTION

In this section you find a discussion on the related topics of Spectrum Policy and Planning followed by Technical Standards and Allocating Spectrum:

2.2 Policy

2.3 Spectrum Planning

2.4 Technical Standards

2.5 Allocating Spectrum

For more information on these topics, please click the appropriate heading in the Table of Contents in the left navigation pane on this page.

Regulators of the spectrum have to make decisions about how it can be used and who should be allowed to use it (i.e., uses and users). While the international framework for the utilization of the radio frequency spectrum is set out in the ITU's Radio Regulations, there is considerable flexibility for the establishment of national policies within this framework.

Determining who may use the spectrum within a given country requires a certain degree of planning, the extent of which depends on how much the regulator wishes to rely on the market. The greater the reliance on the market, the less planning is required.

This difference is revealed if we contrast the emphasis on planning under administrative and market based spectrum management approaches. Four phases of planning are described in the ITU-R Report SM.2015 on Long-Range Planning referenced below. The four planning steps are:

- Determining spectrum requirements;
- Determining spectrum availability;
- Considering spectrum planning options;
- Spectrum planning implementation.

Under a market based approach and with the caveat that sufficient spectrum has initially been made available for the market to properly function, the regulator can be less active in leading the determination of spectrum requirements and availability since these adjustments will take place between users. Also with the advent of advanced technologies and the use of the spectrum commons, the requirement for band planning could be curtailed. For more a detailed discussion on market mechanisms and spectrum sharing see Section 5: Spectrum Sharing.

5.2.2 INSTITUTIONAL FRAMEWORK FOR SPECTRUM MANAGEMENT

International, regional and national regulatory frameworks significantly influence spectrum policy formulation, harmonization and implementation.

As reviewed in more detail in Section 7 - International Affairs, the ITU harmonizes the efficient use of the spectrum resource on a global basis on behalf of governments. Ultimately, the implementation – how and when recommendations and regulations are implemented – rests with national governments. Allocations of radio spectrum are agreed upon at the ITU World Radiocommunication Conferences (WRC) for each ITU Region, and the Radio Regulations are then revised. Agreements on changes to allocations made at WRCs have treaty status, and international harmonization and coordination of spectrum allocation are essential for many public sector services, such as transport.

Practices across regions vary and decisions made about spectrum allocation vary across the three ITU regions. Region 1 has multiple sovereign markets and attempts a unified approach. Region 2 is dominated by the US and often reflects a single market approach whereas there multiple sovereign markets and no real unified approach across Region 3 encompassing Asia-Pacific and Oceania.

In Europe, common positions in relation to WRC agenda items are developed by the European Conference of Postal and Telecommunications Administrations (CEPT); the CEPT includes 48 European member states. The European Union presents a particularly unique situation with broad policy in terms of goals, direction and timelines set on a pan-national basis, while the detailed implementation of policy is left to individual member countries. Much like North and South America, there is no formal process for setting a common agenda in Asia to coordinate and harmonize policy or spectrum use.

One of the hurdles in establishing coordinated policy at the national level is diverse regulatory framework for broadcast and telecommunications:

- in some cases, there is one regulator for both broadcast and telecommunications, and;
- in other cases, the regulation of these services is divided between separate regulators.

At the beginning of 2011, separate regulators had been established in more than 80 per cent of countries, totaling 158 regulators worldwide, up from 106 regulators a decade ago. Africa has the highest percentage of regulators (relative to the total number of countries in each region) with 93 per cent, followed by the Americas and Europe with 91 and 88 per cent, respectively. Moreover, Asia-Pacific has 73 per cent, Arab States have 71 per cent, and the CIS has the lowest with 50 per cent.

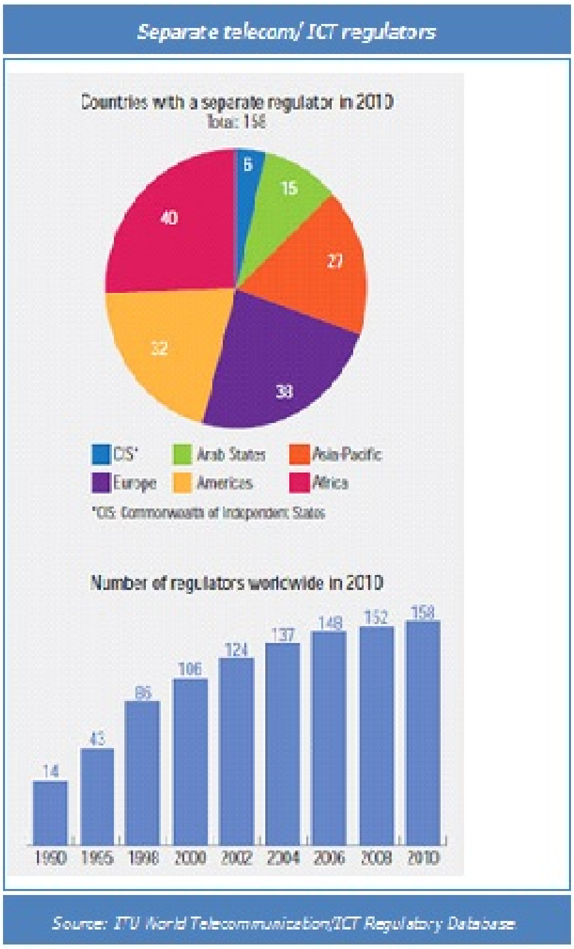
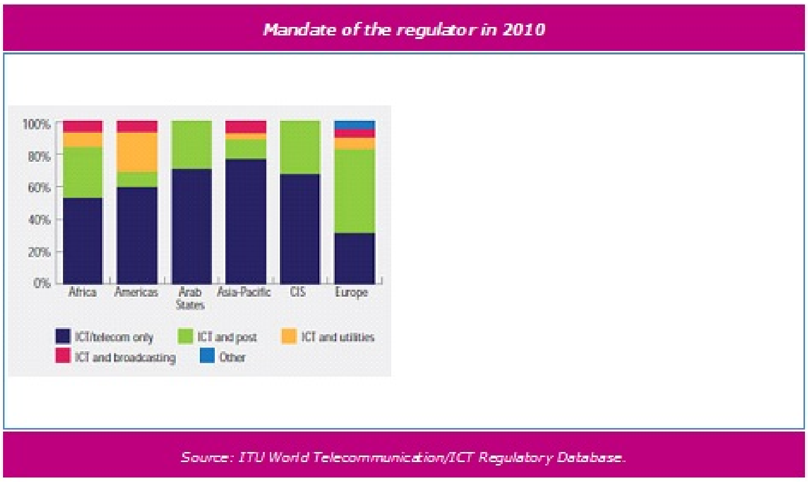


Figure 1 Countries with Separate Regulators, 2010

Photo: ITU World Telecommunication/ICT Regulatory Database

Countries with separate regulators have adopted different institutional and organizational frameworks to adapt to the fast-changing ICT environment. While the main trend in most regions has been to establish a sector-specific regulator, some countries have moved towards merging pre-existing separate regulatory authorities into a converged regulator, while others have expanded the mandate of the regulator to include posts, information technology, broadcasting content, or spectrum management. Figure 2.2 illustrates this issue by illustrating that there is no consistent pattern in regulatory mandate and function across the various regions of the globe.



◀ **Figure 2 Mandate of the Regulator 2010**

Photo: ITU World Telecommunication/ICT Regulatory Database

Several countries in the Americas, Europe and Africa have established multi-sector agencies, either when sector reforms were initiated or after their markets reached a certain level of maturity. In these cases, countries have merged pre-existing separate regulators of public utilities to oversee, for example, the telecommunications, postal, electricity, gas and railway sectors.

In several jurisdictions regulators are now responsible for regulation beyond their traditional core activities. These traditional functions consist of: regulating access to telecommunication/ICT infrastructure and services through licensing; managing scarce resources such as spectrum and numbering resources; dealing with interconnection issues; setting and enforcing quality of service standards; and managing universal access support programmes.

In 2010, 16 per cent of regulators had responsibility for broadcasting content, sometimes sharing that responsibility with another ministry. While Internet content is unregulated in more than 44 per cent of countries worldwide, it is around 13 per cent of telecommunication/ICT regulators' mandates. Information technology is included in the mandate of 30 per cent of regulators, a responsibility that is shared in 12 per cent of cases.

At the policy and standards level, the same diversity is evident. For example, for television systems different standards apply to various regions around the world where there are three dominant analogue television standards: NTSC, PAL and SECAM. There have been some intensive efforts made to achieve cooperation at the regional and trans-regional level to smooth out the process and simplify the inherent diversity. The Geneva Frequency Plan referred to as GE06 is a prime example of such an inititative.

5.2.3 SPECTRUM POLICIES AND PRINCIPLES

At the national level, there are a number of important policy questions to be reviewed and resolved affecting the regulation of spectrum. These policy questions include the government's own use of spectrum with the underlying concern that government departments can under utilize the spectrum assigned to them. Other policy matters include the extent to which market mechanisms should be used to assign spectrum and used to set the price for spectrum; and, what are the permanent or temporary property rights of licensed and unlicensed users. These and other policy questions are raised in the balance of this Section.

Spectrum Managers can assist the Government and National Regulatory Authority by leading the development and approval, after extensive and meaningful stakeholder input and consultations, of spectrum policies governing spectrum's use, its licensing, spectrum prices, and refarming. Good policies are essential for better decisions to be made more quickly, thereby reducing the risk of regulatory and market failure. Spectrum policies include pronouncements on regulatory direction for the following:

- Spectrum planning policies including the study and assessment of spectrum demand and supply for government and non-government uses, and requirements for band plans;
- Spectrum authorization policies including the use of spectrum auctions, development of spectrum user rights, technical and service neutral assignments and authorization;

- Spectrum pricing policies including objectives, use of incentives, basis for recovery, and implementation of market-based spectrum prices;
- Specific policies for refarming and re-allocation done in conjunction with the development of spectrum user rights, valuation and spectrum pricing.

Core principles should guide policy makers, regulators and ultimately the users of radio frequencies in the management of spectrum. Best practice core principles include the following:

- Spectrum should be allocated to the highest value uses or uses to ensure maximum benefits to society are realized;
- Mechanisms should be put in place to enable and encourage spectrum to move to its highest value use;
- Greater access to spectrum will be facilitated when the use the least cost and least restrictive approach is chosen in achieving spectrum management goals and objectives;
- To the extent possible, regulators and spectrum managers need to promote both certainty and flexibility;
- Balance the cost of interference with the benefits of obtained from greater spectrum utilization.

Harmonized spectrum use with international and regional allocations and standards will reap additional benefits in terms of access and economies of scale and should be pursued, except where Moldova's interests warrant a different determination

Practice Notes

- **European Parliament and Council Decision on a Spectrum Policy ProgrammeArticle 8a(3) of Framework Directive 2002/21/EC as amended by Directive 2009/140/EC**

Reference Documents

- **Chapter 2 of the 2005 Edition of the National Spectrum Management Handbook**
- **European Commission Communication on Next Steps in Radio Spectrum Policy, European Commission, 10 November 1999**
- **GSR 2012 Spectrum Policy in a Hyperconnected Digital Mobile World. Discussion Paper, ITU.**
- **ITU-R Report SM.2015 on Methods for Determining National Long-Term Strategies for Spectrum Utilization**

5.2.3.1 SPECTRUM POLICY REVIEW

Spectrum management policy and practice have been the subject of considerable debate and reform over the past decade and the debate is likely to continue into the future. Over the past decade, spectrum management practises have been steadfastly diverging from sole reliance on administrative approaches to a greater reliance on market based mechanisms. This shift in approach is most prevalent in the area of spectrum assignment and licensing where the use of auctions and more flexible spectrum authorizations - service and technology flexible licenses are becoming more common. Additionally, unlicensed (but not unregulated) spectrum commons are now common practice - See Section 1.6.3 Unlicensed Spectrum

Increased demand, spectrum scarcity especially below 2 GHz, rapid changes in technology, recognition of the high economic value of spectrum and the use of spectrum prices, and the important changes taking place due to the need for international agreements on harmonized allocations (Broadband and Digital Switchover) are driving the need for review and reform. Several country examples are listed below.

United Kingdom – Flexible User Rights and Spectrum Trading

OFCOM is currently shifting UK spectrum policy towards a flexible system of spectrum management. It is liberalizing spectrum usage rights and spectrum trading. A gradual approach is being adopted, embracing progressively more bands and greater flexibility but relying on competitive assignment methods. This progression is exemplified by OFCOM's intention to apply service and technological neutrality in a forthcoming spectrum assignment involving frequencies currently used to support terrestrial analog TV broadcasting. OFCOM also is proposing spectrum user rights in a forthcoming auction of the L band, and in other auctions.

The UK has also adopted a policy of extending market methods of spectrum management to public sector spectrum, giving public sector users the right to trade or lease their spectrum and the obligation to go into the market place to acquire additional spectrum. OFCOM is also extending the application of administrative incentive prices (AIP) to government agencies, requiring them to pay commercial prices for their existing spectrum, as set by regulators - See Section 5.8 Administered Incentive Prices.

India - Spectrum Management Review

In October 2009, the Telecommunication Regulatory Authority of India published a consultation paper examining a broad range of spectrum management activities and issues with central focus on:

- Spectrum Requirements
- Spectrum Licensing, and
- Spectrum Assignments

The consultation process completed in early 2010 and the TRAI has published a paper with recommendations on a range of issues on May 16, 2010.

Spectrum Requirements

The issues considered include:

- How much government spectrum should be refarmed and what are the suggested best methods for re-farming spectrum?
- What will be the impact of the Digital Dividend?

Spectrum Licensing

The issues considered include:

- Should spectrum trading be permitted and when?
- Should spectrum caps be used and what are appropriate spectrum block sizes?
- ppropriate conditions for spectrum sharing; and
- Types of spectrum authorizations.

Spectrum Assignment and Pricing

The issues considered include:

- De-linking spectrum licenses from telecommunication licenses;
- When to use market-based mechanisms?
- How should non-commercial spectrum be assigned?
- Should annual spectrum charges be used and how often should they be revised?
- How should the spectrum management organization be restructured to better reflect spectrum management recoverable costs?

5.2.4 SPECTRUM PLANNING

Spectrum planning processes provide direction and cohesion in support of policy formulation, and support future steps to achieve optimal spectrum use. Major trends and developments in technology and the needs of both current and future users of the frequency spectrum should be closely monitored and mapped. The types of user requirements for systems utilized to conduct frequency management activities, like monitoring systems, channelling plan techniques, and tools should also be planned and developed.

The various aspects of planning at both the international, regional, national and local level are discussed in this toolkit. Information on planning at the international and regional levels may be found in **Section 7 on International Affairs**.

5.2.4.1 PLANNING TIMEFRAMES

Planning is usually undertaken for long-term, medium-term and short-term timeframes. Long range (strategic) planning (10 to 20 years) is required to foresee spectrum requirements far into the future. Such long-term planning must take into account the need to accommodate uses that may not have been predictable at the time of inception. Determining those needs is best done by involving both spectrum managers and stakeholders, as the future needs of a given radio service and the various spectrum management approaches that might be applied are of interest to both of them. Medium-term planning (5 to 10 years) is needed to determine what changes should be made to regional, sub-regional, national and local spectrum policies to meet the changing needs of users and evolving technology that have already been identified. Finally, short-term planning (anything under 5 years) is important where, depending on the nature of spectrum governance in place, changes to spectrum policies can be made to adjust earlier decisions.

Reference Documents

- ITU: Spectrum Management Systems for Developing Countries, 2006

5.2.4.10 CONSULTATION WITH STAKEHOLDERS

Consultation with stakeholders is essential in virtually every aspect of spectrum management including the development of national legislation and regulations, spectrum policies, technical standards, etc. While it is seldom practical to consult with each individual spectrum user, effective consultations can take place by also allowing associations or bodies representing groups of users to contribute. In order to facilitate consultation on important spectrum management issues, it is important that the spectrum regulator's proposals be made public. In some countries, this is in any event required under broader national legislation governing all regulatory activities, perhaps by a requirement for setting out proposals in an official or widely-distributed publication. Sometimes, several options may be presented for public comment. It may also be helpful to allow for exchanges between interested parties. Often, meetings are held between the spectrum regulator and relevant stakeholders and the Internet has increasingly become a standard tool for such consultations. Regardless of the means for obtaining input, minimal guidelines allowing interested parties to contribute gainfully should be set, such as allowing for a given period of time, with a deadline by which comments must be submitted. In all consultations, transparency and fairness are paramount. While it deals with somewhat different subject matter, more information on the consultation process may be found in **Section 6.2 of Module 3 on Authorization of Telecommunication/ICT Services**.

RELATED INFORMATION

Authorization Module, Section 6.2.1: The Public Consultation Process

Practice Notes

- Canada: Policy Statements - Planning, Consultation (National and International)

Reference Documents

- Hong Kong: Consultation on Spectrum Reform (refarming), 2006
- India: Consultation Paper on: Efficient Utilization, Spectrum Allocation, and Spectrum Pricing, 2004
- The Public Consultation Process - ICT Authority Consultative Document
- Venezuela: The Introduction of 3G Services - A Public Consultation Document

5.2.4.11 DISPUTE RESOLUTION

It is quite likely the increased use of spectrum utilizing either market-based or administrative approaches will raise issues which need to be resolved between parties. In the past, this has involved intervention on the part of the regulator which has proven to be difficult in terms of time and cost.

There are two trends at work:

- Rapid changes in the telecommunications sector; and
- Changes in the realm of dispute resolution procedures.

The expansion of the global telecommunications market with its emphasis on innovative and fast-changing technology mechanisms for resolving disputes requires resolution procedures which are not only fast and flexible – but also suited for the types of disputes that the global telecommunications industry produces. In turn, the dispute resolution field is increasingly offering new models that may be useful to the telecommunications sector's new needs.

While most regulators decide between the positions of disputing parties, typically after a formal process that involves the presentation of arguments by those parties, there is a trend towards more flexible and consensual methods – alternative dispute resolution (ADR) including: negotiation and arbitration (for more on dispute resolution see the ITU World Bank report on Dispute Resolution) . Most telecommunications licenses include guarantees of access to arbitration. Even so, it is helpful to have developed guidelines for managing ADR processes such as those issued by Ofcom governing ADR between public telecommunications operators and the public that are:

- Independent and impartial;
- Transparent, providing regular communication to the public through out the process;
- Effective with an expectation that the disputes will be resolved within a reasonable timeframe;
- Able to properly investigate disputes and make awards of appropriate compensation.

Practice Notes

- **New Zealand: Devolution of Interference Management under a Management Rights System**

Reference Documents

- **Dispute Resolution in the Telecommunications Sector: Current Practices and Future Directions**

5.2.4.12 FINANCING OF SPECTRUM MANAGEMENT

Funds for financing the cost of regulating the spectrum can come from either general taxation revenues, specific telecommunications charges such as licence fees or other spectrum-related fees or from a combination of these two. It is generally felt that those who benefit from having access to spectrum should pay for the cost of its regulation. Revenues can be obtained in relation to those parts of the spectrum for which access is payable, no such revenue is forthcoming from unlicensed (free) bands. The funding requirement of regulatory activity or change related to these latter cases is probably most efficiently met through general taxation revenue. Such regulatory costs are usually low.

Allowing a spectrum regulator to establish its own charging regime, collecting all spectrum-related revenues, and retaining them to fund spectrum management activities can be a source of concern to policy-makers. In economic terms, the regulator is effectively a monopoly and has little incentive to contain its costs if it can increase its revenues by raising licence fees and other charges. Safeguards can be put in place to avoid such practices, such as putting limits on the growth of the regulator's expenditures.

In countries where spectrum revenues exceed the cost of spectrum management sometimes by a very large margin, governments view this as a spectrum dividend whereby the government, and hence all members of the public, reap the financial benefits of such royalties. However, attention must be paid to the broader legislation within a country, as spectrum revenues in excess of costs may be viewed as taxation. The power of taxation may be reserved by another government entity and the legislation dealing with spectrum management may or may not be constructed so as to allow revenues to exceed costs.

The cost of spectrum management immediately raises issues of cost accounting. For example, what costs should be included in the total cost of regulating the spectrum. What indirect costs or overheads should be included, etc.? For a more complete discussion of this, see **Section 5.2 Cost Recovery**, in this module.

Reference Documents

- **Policy on Service Standards for External Fees**

5.2.4.2 KNOWLEDGE OF CURRENT SPECTRUM USE

Broad decisions on spectrum use and changes to allocations are made at global and regional ITU radiocommunication conferences. World Radio Conferences (WRC) are held usually every four years. The last WRC held in 2007 resulted in major changes to IMT while the next WRC planned for 2012 will address a broad range of allocation issues across most of the bands. See Section 7.2.2 on Recent ITU World Radio Conferences.

Each country prepares its own allocations which usually impose further restrictions on spectrum use and decisions are then formalized in the National Table of Frequency Allocations. For a discussion and review of several examples see Section 2.4.6 National Frequency Allocation Table.

One of the spectrum manager's key responsibilities is to ensure the optimal use of the radio spectrum under its management. Radio spectrum is a major asset contributing significant value to the national economy each year and underlines many aspects of users lives. Radio communications is critical to areas such as air travel, emergency services, cellular telephony, sound and television broadcasting, defence and our utilities.

Many regulators have carefully considered the management of this vital resource. One example is the "Spectrum

Framework Review published by Ofcom in 2005 which sets plans for radio spectrum through to 2010.

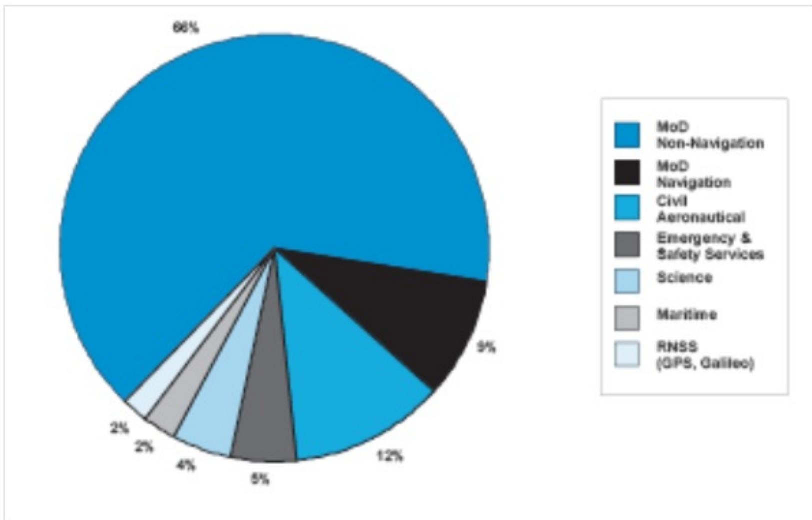
It is vitally important for the spectrum manager and stakeholders to know what are the current uses of spectrum before realistic planning for the future can take place. This can be ascertained from existing records of frequency use across the entire radio spectrum. Information may be held by various organizations and where national records are incomplete or unreliable, public consultation between regulators, service providers and users can help retrieve a complete picture.

For both emerging economies and developed economies, spectrum availability will be key to continued development of telecommunications capability over the next decade. In almost every part of the world, wireless data traffic is increasing year over year. Success with national broadband plans will depend crucially upon spectrum availability and is essential to promoting competition and innovation in the sector. Where spectrum availability is inadequate prices will be higher, market entry limited, and innovation constrained. Success with a national broadband plans is almost inconceivable without strenuous efforts to make spectrum communications available by all means, including refarming and sharing frequencies.

All successful efforts of this kind begin with knowing how spectrum is being used and by whom. Spectrum audits and spectrum demand and supply studies covering all spectrum users, especially government users, lead to steps which can result in new allocations and adjustments between users.

In the UK a Spectrum Audit was conducted in 2007 to determine how spectrum was being used. In addition a ground breaking and revealing study of the demand and supply requirements of the major government user of spectrum in the UK - the Ministry of Defence - was conducted.

As reported in the Independent Audit of Spectrum Holdings to the UK Government in 2005 (the “Cave Audit”), government holdings of spectrum approximated 50 per cent of the UK’s spectrum below 15 GHz. Figure 2.4 below, illustrates the relative share of spectrum between various British government services.



◂ **Figure 2.4: Composition of Public Sector Spectrum Holdings below 15 GHz, United Kingdom 2005**

Photo: Independent Audit of SPECTRUM HOLDINGS: HM Treasury, 2005, Figure 1, page 13

MOD, as the single largest government user of spectrum in United Kingdom, has access to 30% of the spectrum between 100 MHz and 3.0 GHz. Its use is not exclusive – it administers civil applications and shares bands with other users

The most recent study was completed in early 2009 with the UK MOD conducting a forward view of spectrum demand covering 80% of its allocations (2010, 2015, 2027) in accordance with its agreement with Ofcom to perform such a review every 2 years. The study is very illustrative and instructive:

- It shows the depth of analysis involved in assessing demand across a range of services and spectrum bands;
- It demonstrates how spectrum prices based on AIP have resulted in two important changes which are noted in the report:
    - Prior to AIP, the MOD did not factor in spectrum pricing as part of investment and operational decision making
    - Prices reveal surpluses in spectrum leading to another important change where MOD now sees itself managing spectrum needs and not existing allocations.

Finally, a single national frequency register should be created if one does not already exist. Spectrum analyzers and computer-aided tools can be very helpful in conducting spectrum audits of selected bands to confirm occupancy and operating parameters.

Practice Notes

- Online Spectrum Registers: Canada and New Zealand
- Spectrum Audit: United States - 2003

Reference Documents

- Access to Spectrum/Orbit Resources and Principles of Spectrum Management
- Current and Future Spectrum Use by the Energy, Water and Railroad Industries
- European Commission Green Paper on Radio Spectrum PolicyGreen Paper on Radio Spectrum Policy in the Context of European Community Policies such as Telecommunications, Broadcasting, Transport, and R&D. COM (98) 596 final, 9 December 1998
- FCC Staff Study Report on NTIA's Study of Current and Future Spectrum Use by the Energy, Water and Railroad industries
- Technology leapfrogging in developing countries - An inevitable luxury?
- Technology leapfrogging in Thailand: Issues for the support of ecommerce infrastructure
- USA: FCC - Current Spectrum Uses, 2002

5.2.4.3 PLANNING FOR FUTURE SPECTRUM USE

Planning and forecasting future spectrum requirements is critically important activity for GNCC which is done to ensure future spectrum needs and demands can be met. Forecasting spectrum use is a challenge that can be overcome by employing various techniques. Projections based on historical growth of, for example, the number of land mobile systems is one method of forecasting growth. Monitoring new technologies and noting their spectrum requirements is another method. It is very important to consult with spectrum users since they are usually in the best position to forecast growth in their sector. One must temper such forecasts, however, as there may be a tendency to overestimate future needs.

An important planning capability exists at the international and regional level through the ITU World and Regional Radio Conferences which consider the impact of growing demand caused technological innovation and news services or improvements to existing services and the impact on planned changes to spectrum allocations. The objective is to ensure that adequate spectrum is available for future use.

Here we focus on two examples of information that are similar in nature and are helpful in determining future spectrum requirements:

- Future service areas enable by technology innovation; and
- Broad categories of drivers of increased demand for spectrum by band;

Future Service Areas using Whitespaces

- Rural Broadband ProvisioningBy upgrading to whitespace radio wireless internet service providers will be able to extend the range of their access points and remove the need for a line of sight between subscriber premises and the access point. This will lead to greatly reduced costs of installing a network infrastructure.

Municipal Wireless Networks

- Municipal whitespace networks could deliver good coverage with a huge reduction of the number of base stations, potentially making municipal networks profitable.

In-home media distribution

- Existing WiFi networks struggle to provide the high bandwidth and quality of service needed to support video streaming, particularly for high-definition video. The ability of whitespace radio to penetrate walls makes it an interesting technology for video distribution around the home.

Spectrum Drivers for Specific Services

Aeronautical and Maritime Services - Communications, Navigational Aids and Surveillance

There are several developments in new systems which will likely drive demand:

- Development and renewal of large scale applications for navigation and surveillance of aircraft and ships include ground based, airborne and ship borne radars, automatic dependent surveillance broadcast (ADSB);
- GPS augmentation systems (including capability for landing guidance).

Broadcasting - Radio and Television

One of the primary influences on the demand for spectrum will be Digital Switchover. Demand for spectrum in broadcast services will be primarily driven by changes in the way Television broadcast is delivered. There are typically three platforms used to deliver TV to households:

- Cable (coax or ADSL)
- Satellite
- Terrestrial Broadcast Networks

Where there are high levels of penetration using cable and satellite, opportunities exist to provide non-terrestrial DTV services either in a competitive model or as the sole provider of DTV services in rural markets.

Cellular

Mobile phones are becoming ubiquitous on devices for 24/7 communication and mini-computing. The recent success of Blackberry, iPhone and other smartphone variants have spurred operators to push ahead with their 3G plans and some will begin to plan for new technology types such as TD-SCDMA, LTE, WCDMA. This growth in demand for bandwidth creates additional demand for fixed links. It is quite likely that technological constraints will cause any additional demand to be concentrated in bands below 3-4 GHz.

Land and Public Mobile Radio

End user demand for new consumer oriented land mobile systems such as Family Radio Systems and GMRS (462/467 MHz) are increasing. In a not so recent study (NTIA 1995) of the importance of land mobile radio systems for public safety, a need for 200 MHz of additional spectrum within 10 years was identified based on a prediction that the number of systems was expected to double between 1995 and 2005 . Existing land mobile spectrum meeting increased demand for mobile communications continue to operate in very congested urban areas. Digitization of land mobile systems has created efficiencies and cost reduction, which have opposite effects on demand. Digitization leads to spectral efficiency while cost reduction promotes overall demand for systems.

Fixed Links - Backhaul Services

Demand for fixed links is driven by: cellular operators and utility operators. As the user demand increases for cellular services, wireless operators require more bandwidth for back-haul. Although fixed links are very important to utilities demand tends to remains fairly static.

Fixed Wireless Access Services

In many countries especially emerging economies, mobile broadband is all but displacing fixed broadband in new long-range high power deployments. Demand will be influenced by choice of markets (urban highly concentrated and highly penetrated markets and rural areas) and choice of technologies (WCDMA, WiMAX, LTE, FDD or TDD) and whether there are new entrants. End user demand has been characterized by increasing demand for data over voice with new applications appearing such as Video-MMS and Mobile TV, which require significant band width. Currently, spectrum is in higher bands, which permits re-use, but at a cost. Short range deployments continue to grow with rapid development of new technologies and devices using primarily unlicensed bands.

Practice Notes

- Canada: Pricing Policies Cost Recovery
- New Zealand - Reallocation of Commercial Spectrum Rights

Reference Documents

- Background paper - Radio Spectrum Management for a Converging World
- Hong Kong: OFTA, Frequency Bands for Broadband Wireless Applications, 2006

- Ireland- Consultation Paper – Future Regulation of Electronic Communications Networks and Services: Arrangements for General Authorisations
- ITU Workshop - Radio Spectrum - Briefing paper
- Spectrum Management for a Converging World : Case Study Guatemala
- Spectrum Management for a Converging World : Case Study United Kingdom
- Strategies and Policies for Wireless IT Promotion in Korea
- Wireless Networks for a Developing World : The Regulation and Use of License-Exempt Radio Bands in Africa,
- Wireless Networks for the Developing World: The Regulation and Use of License-Exempt Radio Bands in Africa

5.2.4.4 SPECTRUM IN TRANSITION

There are many new radio technologies exploiting the capabilities of the Internet: ranging from fixed to mobile devices that are capable of receiving audiovisual content such as movies, TV, and games. Technology is not the only thing changing. Consumer behaviour and technology used by individuals and whole segments of society are changing, and the lines between services such as telephony, computing, television viewing, radio listening, and media access (with mobile device options) are becoming increasingly blurred. Spectrum in transition focuses on Digital Switchover, Digital Dividend and Broadband, all of which are reviewed in this section.

Digital Switchover and the Digital Dividend

Digital Switchover and Digital Dividend are two related concepts. The Digital Dividend is a consequence of the Digital Switchover having taken place. Digital Switchover occurs when analogue television broadcasting signals are converted to and replaced by digital television services. Sometimes this occurs abruptly and is referred to as Analogue Shut-off whereas in other circumstances, analogue and digital signals co-exist for a period of time during the transition.

While digital signals are not necessarily better than analogue signals for recording or broadcasting, especially in terms of frequency response, signal-to-noise ratio, or dynamic range, there are, however, definite efficiencies to be gained through the use of digitally transmitted signals. Moreover, new broadcast services such as distinct simulcast programming can be offered using digital multiplexing.

The fundamental reason why the Digital Dividend spectrum is so important is its physical characteristics: an exceptionally attractive combination of capacity (bandwidth) and coverage. The Digital Dividend can be used for a very wide range of potential new services. These include additional television services delivered through Digital Terrestrial Television (DTT) (whether in standard definition (SD) or high definition (HD)), local television, new types of mobile broadband, mobile television, and wireless home networks, to name just a few. There are many new technologies exploiting the capabilities of the Internet: ranging from fixed to mobile devices that are capable of receiving audiovisual content such as movies, TV, and games.

Generally speaking, the Digital Dividend resides in the range of broadcast spectrum – VHF (30 MHz – 300 MHz) and UHF (300 MHz – 3.0 GHz). There are several definitions of the Digital Dividend. The most common definition is the amount of spectrum in the VHF and UHF bands that is above that amount nominally required to accommodate existing analogue TV programmes and that might be potentially freed up in the switchover from analogue to digital television. Spectrum is freed-up since digitally transmitted broadcast services require less spectrum than the amount needed to accommodate existing analogue transmissions (principally, television).

Technological advances are being accompanied by changes in use and behaviour, as well. Viewing behaviour is increasing because of the Internet, especially amongst younger audiences. Viewers now use a range of devices capable of receiving audio-visual content such as movies, TV, games, and so forth. The lines between television viewing and radio listening and between PC and mobile device options are opaque. These trends have been reported in several instances, particularly in developed countries such as in the Republic of Korea and in the UK, but also increasingly in developing countries:

- Since 2008, Ofcom (see Ofcom, Communications Market Studies) has been reporting an important reversal in trends in TV viewing for British audiences. Despite the growing choice in technology and services available, watching TV remains the activity that most adults would miss the most. Compared to 2007, a growing number of 16-24s (8 percentage points) and over 55s (7 percentage points) say that watching TV is the activity they would miss the most if no longer available;
- However, from 2003 to 2008, UK TV revenue as a whole contracted for the first time since 2003, down by 0.4 per cent in 2008 to £11.1bn. Net TV advertising revenue also declined by 9.6 per cent to £3.1 billion, which is the biggest fall since 2003;

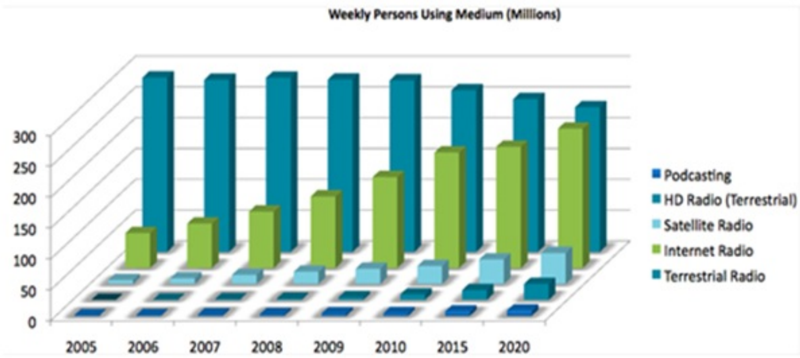
- In 2009, the Korean Communications Commission (KCC) reported observing significant new trends. The number of IPTV subscribers in Korea is rising sharply while other forms of subscription television access are declining;
- Services like Terrestrial Digital Multimedia Broadcasting (T-DMB) are also making viewers move away from traditional television services. T-DMB first came on the air in 2005 in Korea and is a free service supported by advertisers. T-DMB had nealry 22 million subscriber in 2009. Today T-DMB is in operation or in trials in a number of countries including Mexico, Germany, Norway, Indonesia, and Malaysia.
- The global media market, valued at USD 1.3 trillion in 2009, is forecasted to grow at an annual average rate of 2.7 per cent to reach USD 1.6 trillion by 2013.
- Terrestrial TV advertising is expected to decline while global multichannel TV will grow and increase according to industry reports, with advertising expenditures growing 1.4 per cent in 2009 to hit USD 19.2 billion in spite of a slowing economy.
- The global trend in growth masks some sharp regional contrasts. The multichannel TV advertising market is expected to shrink 0.9 per cent in North America, but is forecasted to grow 0.6 per cent in Western Europe and 15.3 per cent in Eastern Europe and the Middle East.
- A milestone was reached in the UK in 2009. For the first time, advertisers spent more on Internet advertising than on television advertising, with a record £1.75bn of online spending recorded in the first six months of that year
- Digital Terrestrial TV – DTT;
- Broadcast Mobile TV;
- Commercial Wireless Broadband; and
- Commercial Wireless Broadband and Public Protection and Disaster Relief.

Overall global trends in media are clearly evident with some different regional tendencies:

Viewing behaviours and attendant revenues are not the only things changing. Methods for accessing television are changing, too. Generally, fewer people are accessing television broadcast through over-the-air means. Triple play take-up is on the rise as well, with more consumers moving toward converged service packages offered by telcos. In several OECD countries (Belgium, Luxembourg, Netherlands, and Switzerland), traditional over-the-air analogue broadcast transmission was, for the most part, already eliminated by 2007.

The trend diverging from accessing television through terrestrial means will likely continue in developed countries but less so in developing countries. In developed economies, new services such as Digital Mobile TV access represent an emerging market with possibly as great a potential as Internet Radio. The projections shown in Figure 1. illustrate the trend in the US. According to these projections, terrestrial radio will remain an important means of media access, showing some decline in total listening while substantial growth occurs in two services, namely Internet Radio and potentially radio over mobile phone (similar to T-DMB in the Republic of Korea). In developing countries, sales of traditional terrestrial radio receivers can be expected to show continued robust growth.

◂ Box 2.4 Global Media Trends
Source: Informa Telecoms & Media (2009)



◂ Figure 2.4.4: Growth in Internet Radio
Photo: Source: Bridge Ratings LLC, 2010.

Digital technology, ubiquitous digital media access, and new multi-media services have transformed markets creating new demands from consumers and businesses. These changes have also altered the map for both new and existing service providers in many ways. Traditional terrestrial television broadcast competes with and in some cases has been replaced by other wired and wireless means of access, which are gaining the upper hand. Terrestrial digital radio broadcast continues to hold its own against new forms of access in developed markets and is likely to grow in developing markets. Changes in consumer demand are not uniform across all markets, and the technologies used by different consumer groups are not the same. With the release of the Digital Dividend spectrum, new opportunities open for expanding existing services and introducing new services for end users.

Furthermore, different spectrum bands in each region are affected by the Digital Dividend. The International Telecommunication Union (ITU) has been leading global spectrum allocation efforts over the past decades. Analogue broadcast services traditionally occupied several frequency ranges in the UHF and VHF bands. The band plans and technical standards vary across the three regions of the ITU. Because markets are different and the bands and technologies used vary, different timelines for Digital Switchover have evolved (see Table 2.4.4 below).

◂ Table 2.4.4: The Digital Dividend by ITU Region

Band	Region 1	Region 2	Region 3
698 - 806 MHz		698 - 806 MHz (2)(3)	
806 - 862 MHz		806 - 862 MHz (2)(4)	
698 - 790 MHz			698 - 790 MHz (5)
790 - 862 MHz	790 - 862 MHz (1)(6)(7)		790 - 862 MHz
Digital Dividend Spectrum	72 MHz (8)	164 MHz	164 MHz

Notes: (1) Identified for IMT services on a primary basis past 17 June 2015.

(2) Identified for IMT services on a co-primary basis. Effective now with various dates set for DSO (USA, 2009; Canada, 2011; Mexico, 2022).

(3) Brazil has opted to allocate 698 - 806 MHz for IMT on a secondary basis.

(4) The USA had decided earlier in 2003 to vacate broadcast services from the 700 MHz band.

(5) China, India, Japan, New Zealand and Singapore opted to identify the 698-790 MHz band, in addition to the 790-862 MHz band, which was accepted by all countries in the region.

(6) The European Commission adopted the policy of analogue shut-off for 790-862 MHz to take place 1 January 2012. COM(700)2007.

(7) The EC approved harmonized technical rules for the use of the 800 MHz band (790-862 MHz) for mobile broadband 2010/EU/267.

(8) In 2003 Ofcom allocated 112 MHz of spectrum for the Digital Dividend resulting from DSO..

Source: McLean Foster & Co., based on the ITU Radio Regulations 2006.

How the Digital Dividend is used varies from one country to another, owing to national circumstances such as geographical position, size and topography, penetration of satellite/cable services, and spectrum usage in adjacent countries.

The main uses for the Digital Dividend spectrum will include broadcasting and fixed telecommunication services, as well as a mix of both over mobile platforms:

Wireless Broadband

Broadband typically means having instantaneous bandwidth > 1 MHz, supporting data rates > about 1.5 Mbit/s over the traditional PSTN or cable networks or supporting speeds through a wireless interface (3G, WiMAX for example) that are roughly equivalent to broadband wireline. Currently there are two main options for achieving wireless broadband rates 3G and WiMAX. Both options are converging with common technology platforms.

Each is briefly described below.

Third Generation – 3G Telephony Systems

According to the International Telecommunication Union (ITU) International Mobile Telecommunications 2000 initiative ("IMT-2000") third generation mobile ("3G") system services started becoming available in the year 2000. In some analysts' view, market take-up really didn't commence until 2005-2006.

3G systems support high-speed bit rate data transfers of circuit and packet switched data and allows roaming access to a wide range of multi-media services. Although data rates are definitely higher than 2G and 2.5G (GPRS) systems they technically fall below broadband rates.

WiMAX

WiMAX, an acronym for Worldwide Interoperability for Microwave Access, based on the IEEE 802.16 standard, as a wireless digital communications system intended for wireless "metropolitan area networks." IEEE 802.16 is split between IEEE 802.16d, or "fixed WiMAX," which does not allow for handoff between base stations, and IEEE 802.16e, or "mobile WiMAX," which allows fixed, nomadic, portable and mobile capabilities.

Evolution to 4G Systems - LTE

Ultimately 3G and WiMAX converge as 4G systems that utilize OFDM (orthogonal frequency division multiplexing). IP transport will be able to achieve high-speed broadband data rates and be capable of mobile communications.

It is worth noting that mobile WiMAX and the evolution of W-CDMA and CDMA2000 1xEV-DO (4G) towards enhanced broadband capability involve the use of common technological building blocks.

While Broadband Penetration and growth have been slow to get started wireless broadband subscriptions in OECD countries do exceed over half a billion by the end of 2010, an increase of more than 10 percent in six months (according to data from the OECD). Fixed broadband subscriptions reached 300 million, but growth slowed to 6 percent year-on-year. Penetration rates for wireless broadband are accelerating in developed and developing countries.

5.2.4.5 THE RADIO REGULATIONS

The ITU Radio Regulations incorporate the decisions of the World Radiocommunication Conferences (see **Section 2.3.3 Planning for Future Spectrum Use**), including all Appendices, Resolutions, Recommendations and ITU-R Recommendations incorporated by reference.

Practice Notes

- ITU - The Radio Regulations - Edition 2008

5.2.4.6 NATIONAL FREQUENCY ALLOCATION TABLE

For an explanation of spectrum allocations, spectrum designations and radio services, see **Section 2.5** of this module of the toolkit. Developing a national frequency allocation table is one of the first steps in long and medium-term planning. A national frequency allocation table should be developed within the framework of the ITU's Radio Regulations; Article 5 of those regulations sets out the international frequency allocation table for all three Regions of the world. The national frequency allocation table should be consistent with that country's regional allocations. That being said, the ITU allocation table will often contain more radio services than may be required or desired in a national setting and some aspects of the international regulatory provisions may not apply in the given country. Once a national frequency allocation table is developed, further sub-allocations or designations of use are often made in order to group like technologies or like users in a given frequency band. It is preferable to make sub-allocations or designations to uses rather than to users since users can sometimes view portions of spectrum as their bands. Generally speaking, greater spectrum efficiencies are obtained when uses with similar technical parameters share the same frequency band, for instance lumping high power applications with other high power applications. Further information on allocating spectrum can also be found in **Section 2.5** of this module.

Reference Documents

- A Proposal for a Rapid Transition to Market Allocation of Spectrum
- Australia -- Five Year Spectrum Outlook, 2009-2013
- Australian Radiofrequency Spectrum Plan
- Canada: National Table of Frequency Allocations
- ITU: Radio Regulations, 2004
- Kenya -- Table of Radio Frequency Allocations, 2008

- Table of Radio Spectrum Allocations in Canada
- United States -- FCC Online Table of Frequency Allocations

5.2.4.7 NATIONAL LEGISLATION AND REGULATIONS GOVERNING SPECTRUM USE

The legal basis for the regulation of the spectrum must be set out in legislation and detailed in regulations made pursuant to the legislation. Legislation should set out such things as definitions, powers of the Minister or head of the spectrum regulatory authority, the powers of others involved in spectrum regulation, offences and punishments and the organizational structure and framework for regulation of the spectrum, a discussion of which may be found in the spectrum overview of **Section 1.6 Governance and Outsourcing**. In addition to the legislation and regulations, there may be other publications issued by the spectrum regulator which provide guidance to a specific group or groups of users of the spectrum.

Something to consider when establishing the legal framework is the use of incorporation by reference. Since legislation or even regulations are usually not frequently amended, often incorporation by reference is used to give legal effect to subservient text or documents. Under incorporation by reference, texts in one document having a certain legal status, such as the legislation or regulations, may cite other documents which normally would not have the same legal status and depending on the nature of such reference, such incorporation may confer the same legal status on these other documents. For example, regulations may state that a certain standard, perhaps developed by an international body, shall apply in a given situation. Such incorporation by reference of texts can be of two types: static incorporation or dynamic incorporation. In the former, a specific document issued at a specific date is referred to in the legal text. In the case of dynamic incorporation by reference, the reference in the legal text is to a specific document but with a phrase like “as amended from time to time” which allows for changes without going through the entire legislation or regulation approval process.

In order to preserve clarity and authority in rule-making, such delegation should be clearly defined. Legislation and/or regulations must make clear who has authority to designate changing sources of external reference when these are not already specified in existing regulation. Such delegation should be set out in a delegation instrument approved by that institution. The development of legislation and regulations and all subservient documentation should be developed in a transparent way with full consultation of spectrum users.

ITU-D has a web site (**http://www.itu.int/ITU-D/ICTEYE/Regulators/Regulators.aspx**) where the legislation of many countries can be found.

Reference Documents

- Australia - The Telecommunications Act, 1997
- Canada - Radiocommunication Act
- Canada: Radiocommunication Regulations, 2002
- European Commission Communication on Next Steps in Radio Spectrum Policy, European Commission, 10 November 1999
- Frequency Open Policy in Japan
- ITU: Radio Regulations, 2004
- Next Steps in Radio Spectrum Policy, European Commission, 10 November 1999
- Nigeria: Communications Act 2003
- Singapore - Info-Communications Development Authority of Singapore Act (2000)
- Singapore - Telecommunications Act
- USA: FCC - Notice of Enquiry and Notice of Proposed Rulemaking, 2003
- West African Common Market Project: Harmonization of Policies Governing the ICT Market in the UEMOA-ECOWAS Space

5.2.4.8 PUBLIC USE SPECTRUM

Achieving public policy economic and social development goes beyond the existence of an applicable and compliant national allocation table. Doing so may require a change in the balance between government spectrum and spectrum allocated to commercial and private uses.

In a market economy, inputs such as land, labour and capital equipment are distributed throughout the economy via market processes: the provider of capital or employee moves to whichever activity offers the best rewards. Spectrum is one input among many others (e.g., water and electricity) in a variety of production processes. Market systems when workably competitive promote economic efficiency, as inputs are put to use where they yield the highest returns.

At first glance, it may seem incongruous to require a public sector body such as a fire service or a defence force to compete in a market place for spectrum with commercial providers of services such as mobile broadcasting. However, this is exactly how public sector organizations acquire other inputs – such as employees, vehicles, land, and office space.

The arguments for special arrangements for spectrum for the public sector seem to be that:

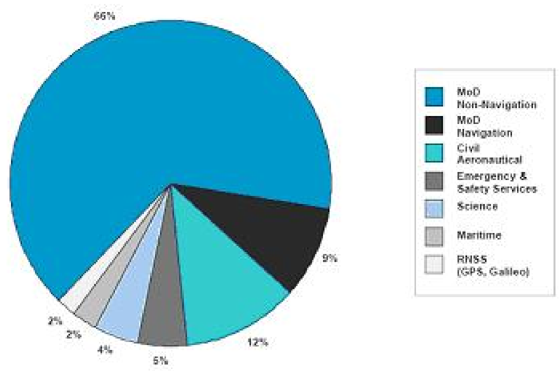
- it is indispensable to the provision of service such as defence radar;
- the service itself (such as an ambulance service) has a very high priority; and
- under past spectrum management practice, the only way to acquire spectrum was by administrative methods.

The use of markets to allocate other equally indispensable inputs into vital public services appears to negate the first two, and the third could be resolved by the development of a spectrum market place.

Government use of spectrum utilized to provide services similar to those provided by the private sector should be, at a minimum, subject to prices reflecting the market price or opportunity cost of spectrum. Where market prices don't apply, some negotiation will be necessary between those holding allocations and those desiring them, along with incentives to ensure the opportunity costs of spectrum are reflected in decisions

Several studies of the amount of spectrum held by government agencies have been conducted in recent years. As an example of leading practice, the United Kingdom table of allocations has allocations for Government Use on an exclusive basis for Civil, Military, and Emergency Services. As reported in the Independent Audit of Spectrum Holdings reported in 2005 by Prof. Martin Cave to the UK Government (referred to here as the Cave Audit), government holdings of spectrum approximate 50% of the spectrum below 15GHz. The UK government reviewed and assessed requirements for all government spectrum holdings and made recommendations leading to improving access to and efficiency of use in spectrum

Figure 1: Composition of public sector spectrum holdings below 15 GHz



◂ Figure I below, illustrates the relative share of spectrum between various government services in the United Kingdom.

To facilitate the process of shifting spectrum allocated to other non-government uses, the following steps could be taken:

- Issue a clear statement of government policy and direction, identifying and setting balanced targets, within sensible but aggressive timeframes for moving government spectrum allocations to commercial allocations;
- Conduct an independent audit of spectrum holdings to identify bands where immediate changes can take place; and
- Put mechanisms in place to begin transitioning allocations and assignments to new uses (commercial applications and assignments) and users. These will likely include:
  - Incentives – where all users pay for frequency assignments unless usage is unlicensed (spectrum commons and personal consumer products are two examples).
  - Compensation for affected users. There are various means to achieve compensation between parties. The

overall process should be encouraged by government but the regulator should not become the payer of last resort between parties negotiating settlements for relinquishing licence rights or equipment under the administrative approach. More flexible licenses and spectrum trading accommodate results for these types of issues.

Reference Documents

- United Kingdom - Independent Audit of Major Spectrum Holdings, 2005

5.2.4.9 RE-ALLOCATING AND REFARMING SPECTRUM

One of the biggest challenges facing spectrum regulators is the reallocation of spectrum. When frequencies have been used for one purpose, perhaps for decades, it is often difficult to reallocate these frequencies for a different use. The need for reallocation – often known as re-farming - can arise in several ways. It may be that the international table of frequency allocations has changed and the national table of frequency allocations must be realigned to be consistent with it. Alternately, a radio service may not have developed as expected, while the spectrum available for another service operating in a nearby frequency band is insufficient to keep up with growing demand. Sometimes, new technologies become available which is more spectrum-efficient, allowing spectrum to be freed up either for the same use in that band or other uses. Whatever the reason, there will be times when spectrum users will have to make changes to their operations. The central issues that arise are then who decides, and who will pay for the costs incurred by these users in transitioning to new frequencies? One solution involves the regulator establishing a re-farming fund by setting aside a portion of spectrum revenues. A Fund for Refarming Spectrum has been established in France and is managed by the *Agence nationale des fréquences*.

Various approaches exist now for re-farming whereby regulators (administrative) address the issues and where users determine the timing and price (market-driven). Some simply require the user to absorb the cost. In other cases, the beneficiaries of the change are either invited or required to reimburse all or part of the transition costs of the incumbent user.

The essential difference between administrative and market-driven approaches is that under the administrative approach the regulator makes the decision while considering several criteria and possible competing objectives such as: logical market-structure, financial, socio-economic, and technical efficiency criteria. The regulator's analyses will include factors such as prices, costs, license conditions, withdrawal, and compensation. Under a market driven approach, the criteria used and analyses centre on financial and business factors with decisions resulting from an agreement between two or more parties.

Re-farming Definition

Generally speaking, refarming may be seen as process constituting any basic change in conditions of frequency usage in a given part of radio spectrum. Such basic changes might be:

- Change of technical conditions for frequency assignments;
- Change of application (particular radiocommunication system using the band);
- Change of allocation to a different radiocommunication service.

Practice Notes

- Examples of Re-farming: US and Japan
- Refarming of Spectrum Resources
- Refarming Tools

Reference Documents

- CEPT: Refarming and Secondary Trading in a Changing Radiocommunications World, 2002
- Hong Kong: Consultation on Spectrum Reform (refarming), 2006
- Replacement of Part 90 by Part 88 to Revise the Private Land Mobile Radio Services and Modify the Policies Governing Them and Examination of Exclusivity and Frequency Assignments Policies of the Private Land Mobile Services, Second Report and Order, FCC,

5.2.5 TECHNICAL STANDARDS

Regulators, users of radiocommunication services and radio equipment, operators and suppliers rely on technical standards as a basis for preventing interference and in many cases ensuring that radio systems perform as designed. Technical standards involve radio standard specification documents, the approval process, as well as testing and certification of radio equipment such as transmitters, receivers and antennas to determine compliance with radio or manufacturer specifications.

From a planning standpoint, the regulator uses technical standards to determine how certain radio equipment will interfere with other equipment in either shared or adjacent frequency assignments. That determination can then be used to develop spectrum use plans. The mutual interaction of radio and electrical products is known as "electromagnetic compatibility" (EMC). Balanced standards frameworks try to minimize business compliance costs while providing effective protection of the radio spectrum resource.

There are two categories of radio system interaction which concern the regulator.

Electromagnetic Interference (EMI) can be viewed as radiocommunications pollution and is sometimes referred to as "radio frequency interference" (RFI). Reducing the level of EMI produced by electrical and electronic products is particularly important where public safety and security services are involved such as aircraft and ship navigation, fire, ambulance and police communications. Under Article 15 of the International Radio Regulations, regulators are required to "take all practicable and necessary steps" to ensure EMI does not cause harmful interference to radiocommunication services.

Radio transmissions can also cause other non-radio electrical and electronic products to malfunction, a phenomenon sometimes known as "immunity" or "electromagnetic susceptibility" (EMS). EMS can also be a safety of life issue, for example, when the use of cell phones interfere with hospital equipment.

This section begins with a discussion of the desired objectives, types of standards and concludes with certification processes and various options available to regulators.

Practice Notes

- **Definitions: Electromagnetic Interference (EMI)**

Reference Documents

- **Electromagnetic Compatibility - the EMC Directive 89/336/EEC, 1992**

5.2.5.1 OBJECTIVES OF TECHNICAL STANDARDS

Technical standards for radiocommunication and radio equipment help to achieve electromagnetic compatibility (EMC) between radio equipment and services such as broadcasting services, navigational aids for aeronautical and marine traffic control, and radiocommunication services including cellular, land mobile, microwave and satellite services. As well, technical standards help by allowing planners and users to minimize interference between radio apparatus and other equipment. The uses of radio frequencies in industrial and commercial applications are important to the economy, so that interference-free use can be an important factor in economic development. Finally, consumers are better served when the quality and reliability of equipment distributed in the country can be improved over time.

Technical standards form the basis for certification and testing of radio equipment. Equipment is said to be certified when it complies with applicable standards of the country. The ITU also has equipment standard regulations for reference by its members. Technical standards and certification processes for specific types of equipment are the same for all manufacturers and importers, ensuring consistent quality for consumers.

Finally, the regulator can require, through technical standards, manufacturers to produce equipment which provides for greater efficiency in spectrum use.

5.2.5.2 SPECTRUM USE STANDARDS

The demand for spectrum is increasing and technology has developed so that radios can perform the same function at previously unused frequencies or require less spectrum capacity, or allow more frequency re-use for the same performance. In many countries and regions and especially in developing countries where growth in telecommunication services is primarily wireless, demand for spectrum continues to increase very rapidly. This increase is a result of expanded use of current services like cellular, radio and precision landing systems for improved aviation safety, and the development of new uses, such as Personal Communications Systems (PCS), digital audio broadcasting, advanced television, and satellite sound broadcasting. In the short term, technical advances needed to meet that demand may exceed the limits of practicality and increase the potential for spectrum congestion and interference. Increasing spectrum efficiency below 3 GHz is more and more difficult and affordable technology in higher bands for consumer wireless communications is not readily available. Spectrum use standards are thus important since they are used to minimize interference between users and systems sharing frequency bands. Spectrum use standards allow regulators to minimize interference regardless of the assignment or authorization method used – Service Based Licences, Spectrum Commons or Licence Exempt.

Spectrum use standards and radio system plans refer to planning documents issued by the spectrum management authority which state the minimal technical requirements for the efficient use of a specified frequency band or bands. They are used in the design, specification and evaluation of technical applications for new radio facilities or modification to existing radio systems operating within the specified band in accordance with a spectrum use policy. A spectrum use standard typically specifies appropriate equipment characteristics relating to efficient spectrum use and not the design of equipment. Spectrum use standards can be designed to match ITU-R Recommendations developed by the Radiocommunication Sector of the ITU in conjunction with the International Table of Frequency Allocations or be developed to reflect unique channelling arrangements formulated to meet national requirements.

Practice Notes

- **Definitions: Spectrum Use Standards**

Reference Documents

- **Canada: Industry Canada, Radio Frequency Spectrum Standards, 2005**
- **Harmonized Standards Institute**
- **New Zealand: Radio Standards, Radio Spectrum Management**
- **Wireless Networks for the Developing World:**

5.2.5.3 COPING WITH CONGESTION IN UNLICENSED SPECTRUM – NO STANDARDS?

In determining the most appropriate regulatory policy regarding unlicensed spectrum, it is necessary to determine:

- Whether there is spectrum which is currently uncongested or can be expected to remain uncongested and so could become unlicensed;
- Whether there is spectrum which is congested, but only because of inefficient usage and where changing the management policy of unlicensed usage would remove the congestion.

There are many factors that influence congestion. Some of these are caused by suboptimal allocation policies and can be expected to be gradually alleviated by the introduction of trading. Some are caused by allowing the use of equipment that is inefficient in its use of spectrum. Others are caused by the nature of the radio spectrum.

There is little that the regulator can do to affect the relative desirability of these bands. However, there are several things that the regulator can control. One of these, which has a significant effect on congestion, is the maximum transmit power.

For terrestrial uses of spectrum, the shorter the range of transmission, the lower the probability that there will be two users operating at the same frequency and in range of each other that might interfere. For example, the whole idea behind cellular telephony in major population centres is the use of low power cell sites so that the same frequencies can be re-used within a relatively short distance. Similarly in satellite communications, the use of spot beams as opposed to global or regional beams allows the re-use of frequencies. Obviously, while the regulator can control these factors to some extent, the radio system's service requirements and system economics are also important factors.

Therefore, if only short-range devices were allowed to use a particular piece of spectrum, the probability of congestion would be lower than for wider coverage applications. Broadly, this has been the regulatory policy to date, with unlicensed spectrum having a maximum transmit power that tended to limit the range to around 100m.

The other factor influencing congestion is the bandwidth and time of transmissions. These mostly depend on the usage. For example, a garage door opener only needs to transmit a short burst of narrowband data and only on a few occasions each day. A W-LAN base station might transmit broadband data almost continuously. The probability of congestion is proportional to this time-bandwidth product or information rate.

Historically, most short range devices have also had a low information rate, but more recently W-LANs and BlueTooth have changed this trend. If the unlicensed bands were restricted to products with a low information rate then congestion would be lower. However, it is quite difficult for the regulator to restrict the information rate in an unlicensed band.

The technical characteristics of receiving equipment (receivers and antennas) also play an important role in spectrum efficiency. If receiving equipment is allowed that cannot easily discriminate between wanted and unwanted signals, more spectrum will be consumed than is technically necessary. However, while some regulators do insist that receiving equipment meet certain standards, other regulators do not. Some others do not regulate receiving equipment explicitly but do so in a de facto manner i.e., specifying only transmitting characteristics and leaving it to users to decide how much interference they can tolerate.

Hence, the main tool at the disposal of the regulator in controlling the level of congestion and the suitability for unlicensed use, is the maximum transmit power, which equates to the range. By enforcing the lowest feasible maximum transmit power, the probability of interference is reduced. Further, the amount of usage will also likely be reduced as some applications will not be viable with short range transmissions. Regulators might have a number of different bands with different transmit power limits to offer users different levels of range and congestion. Alternatively, as an unlicensed band becomes more heavily used, the transmit power might be progressively reduced to new entrants in order to keep the congestion at an acceptable level.

In the past, the number of applications and users of radio spectrum has grown faster than the ability of technology to accommodate them. Hence, congestion has increased over time. However, it has been argued that if a “spectrum commons” approach were widely adopted, then this would reduce the overall levels of congestion. This section considers whether this is likely.

Without regulatory intervention, the problem of dealing with congestion would not be resolved. Equipment will only be made efficient or polite to the extent that it is necessary for that piece of equipment to operate reliably and not for the greater good of all the users of the band.

In summary, many observers conclude that spectrum should be unlicensed if it were unlikely to be congested. It has been noted that:

- Congestion was most likely in the core bands of around 100MHz to 5GHz;
- There is insufficient evidence that taking bands currently considered to be congested and making them unlicensed would alleviate congestion, hence this approach cannot currently be advocated:
- The probability of congestion could be dramatically reduced by restricting the range of devices through controlling the maximum transmitted power or by requiring specific behaviour such as politeness protocols.

Still, there is no definitive way to predict congestion. A judgment needs to be made on the basis of the frequency band, likely use and range. The range in turn depends on the use. Hence, a key stage in predicting the congestion likely in the band is determining the most likely use.

This suggests that the regulator should first come to a conclusion as to the most likely use or uses for the band. The regulator does not need to impose these uses. For example, if the band is subsequently auctioned there is no need to restrict its use to that deemed most likely. However, this decision will be used in the process of deciding whether spectrum should be unlicensed.

Having decided on the most likely use, spectrum should be subject to licensing where any of the following hold true:

- The band is likely to be congested. A way to approximate for this is to assume that congestion would occur if the use would entail a wide area service (i.e. one covering a contiguous area greater than ~1km^2) being offered. Examples of such services are cellular and broadcasting;
- A guaranteed quality of service (QoS) is needed. This is the case, for example, with most public safety communications;
- International treaty obligations provide restrictions that would be breached by operation on a licence-exempt basis either now or at some known point in the future;
- Finally, the regulator will need to make a judgement as to the most appropriate level of restriction.

Essentially, the greater the perceived risk of congestion developing, the more restrictions should be imposed. However, the restrictions should also take into account the likely additional cost imposed on the devices compared to the benefit that might accrue.

Depending on the level of information, it might be possible to perform an economic assessment of the value of the different approaches. For example, where imposing politeness protocols will have minimal impact on the device cost then they might be used without hesitation. Where such protocols would significantly increase the cost and where congestion is unlikely, or has little impact, then they should not be imposed.

Practice Notes

- Coping with congestion in unlicensed spectrum.

Reference Documents

- Wireless Networks for the Developing World: The Regulation and Use of License-Exempt Radio Bands in Africa

5.2.5.4 RADIOCOMMUNICATION EQUIPMENT STANDARDS

Radio equipment standards are technical standards specifying the minimal acceptable technical specifications and performance characteristics of radio equipment in general use. Radio equipment standards exist for both licensed radiocommunication equipment or stations and licence-exempt radiocommunication equipment which include low-power devices such as garage-door openers, radio frequency identification devices (RFIDs) or equipment utilizing ISM or unlicensed bands such as WiFi and WiMAX. Regardless of the licensing and frequency authorization process, radiocommunication equipment standards are established by the spectrum management authority and used by manufacturers to create minimally acceptable technical parameters for radiocommunication equipment. Technical standards documents provide general information describing the equipment and the application; indication of licensing and certification requirements, channelling arrangements, modulation techniques used by the equipment, transmitter power and transmission limits for unwanted emissions.

For a more detailed discussion of radiocommunication equipment licensing and authorization go to **Section 3: Authorization**. Certification of radiocommunication equipment is discussed in **Section 2.4.8**. Channelling arrangements involve spectrum use and are explained in **Section 2.3.2**. Modulation techniques and unwanted emissions are discussed in **Section 6: Monitoring**.

Reference Documents

- Canada: Standard Radio Systems
- Radiocommunications (Radio Standards) Notice 2005 No. 2
- UK: Radio Equipment Standards

5.2.5.5 RADIATION STANDARDS

Radiation standards refer to electromagnetic emissions which, at certain frequencies, may be harmful to life or some other concern to public safety. The spectrum manager is not typically responsible for conducting the research and determining the scientific basis for that concern. Other agencies of government such as the Ministry of Health and public and private research institutes conduct research to substantiate concerns. Once a decision by government on policy or regulation has been reached however, the spectrum management authority may need to take certain measures such as making modifications to radiocommunication equipment standards to ensure public safety.

The study of radiation effects on humans occurs at the national and international level. For instance, the World Health Organization studies radiation effects. The International Union of Radio Sciences in its Commission K addresses the effects of emissions on human health.

Reference Documents

- FCC Spectrum policy task force Staff Working Group Paper Report of the Interference Protection Working Group, 2002.
- FR Radiation and Electromagnetic Field Safety, Hand Book of Radio Amateurs
- Maximum Exposure Levels to Radiofrequency Fields 3KHz - 300GHz
- Standards in Wireless Telephone Networks, Telecommunications Policy, Volume 27, Issues 5-6, June-July 2003, Pages 325-332

5.2.5.6 OTHER STANDARDS

In connection with the deployment of radiocommunication system, other standards relating to the environment, construction and land use may apply. Although the spectrum manager may not be responsible for the development and enforcement of these types of standards, she or he will need to be aware of them and their implications in planning frequency use and licensing. This is particularly true where location with respect to essential facilities such as power transmission lines and airports is a factor.

Reference Documents

- **Canadian Municipalities and Regulation of Radio Antennae and their Support Structures, 1987**

5.2.5.7 STANDARDS DEVELOPMENT AND APPLICATION

The development of radiocommunication equipment standards and spectrum use standards occurs at the national, regional and international levels. In some cases, due to the importance and size of the national economy, national standards acquire international importance. Smaller nations routinely adopt, either formally or informally, radiocommunication equipment standards developed by other standards organizations, which is a cost-effective manner of designing a set of standards. Indeed, countries within almost all regions, including Europe, the Caribbean, Africa and Asia have opted to recognize both European (ETSI) and North American standards (FCC and ANSI). There are standards bodies in most regions of the world and particularly in regions where high technology and telecommunication and radiocommunication equipment are manufactured.

The regional and national standards bodies include: American National Standards Institute (ANSI); European Telecommunications Standards Institute (ETSI), the Australian Communications Forum (ACF), the Association of Radio Industries and Businesses (ARIB), the Telecommunications Technology Association (TTA), etc.. International standards bodies include: The Institute of Electrical and Electronic Engineering (IEEE) and the International Telecommunication Union (ITU).

RELATED INFORMATION

American National Standards Institute (ANSI);

Australian Involvement in International Standardization, Standardization Guide 2005,

European Telecommunications Standards Institute (ETSI);

The Australian Communications Industry Forum (ACIF)

The Association of Radio Industries and Businesses (ARIB)

The Telecommunications Technology Association (TTA)

The Institute of Electrical and Electronic Engineering (IEEE)

Reference Documents

- **European Union: Telecommunications equipment and Mutual Recognition Agreement**
- **IEEE: Broadband Wireless Access, Standards Development**

5.2.5.8 CERTIFICATION

Testing of radiocommunication equipment to establish compliance with national standards is performed by government-operated testing facilities or in private sector laboratories. In recognition of the dynamic nature of technological change and innovation and the high cost of test equipment, national governments are increasingly favoring private sector facilities. Due to the importance of testing and certification, the complexity involved and the reliance placed on results, policies and regulations have evolved around the harmonization of standards across regions and markets. Harmonization has also been promoted by the adoption of consistent approaches through the certification of Conformity Assessment Bodies (CAB's). CAB's are organizations recognized by the spectrum management authority to conduct testing and certification of radiocommunication equipment.

A CAB in one country can be recognized in another country by way of agreement. Mutual Recognition Agreements (MRA's) facilitate trade among countries. They are established on a bilateral or a regional basis, and streamline the conformity assessment procedures for a wide range of telecommunication and telecommunication-related equipment. One such example is the Asia-Pacific Economic Cooperation Telecommunications MRA. These steps reduce the cost of supply of radiocommunication equipment and ensure both quality and conformity. An MRA provides for the mutual recognition by the importing parties of CAB's and mutual acceptance of the results of testing and equipment certification procedures undertaken by those bodies in assessing conformity of equipment to the importing parties' own technical regulations.

Conformity to radiocommunication equipment standards and certification are necessary conditions for interoperability of radio communications services and terminals such as handsets. It is not a guarantee, however. Across a region or within a country, a common technology or standard such as GSM or CDMA may be used by service providers with similar networks but operating at different frequencies, making it difficult for users to migrate between networks. The absence of roaming agreements may also prevent interoperability even when frequencies and the technologies are the same.

Reference Documents

- EU: Mutual Recognition Agreements
- Hong Kong: Equipment Evaluation and Certification Scheme
- Japan: Radio License Procedures and System for Conformity

5.2.6 ALLOCATING SPECTRUM

In establishing what use can be made of the spectrum, allocating ranges of frequencies in what are referred to as bands is a central concept, and is explored through the rest of this section.

Reference Documents

- Comments of 37 Concerned Economists (Federal Communication Commission 2001)
- IEEE: Radio Resource Management in Future Wireless Networks: Requirements and Limitations
- Much Ado About Bandwidth
- Technico-Economic Methods For Radio Spectrum Assignment, IEEE 1995

5.2.6.1 RADIO SERVICES

Radiocommunication is a sub-set of telecommunication. Radiocommunication services are one of the main kinds of radio uses for which spectrum is allocated. Radiocommunication services have been the dominant focus of attention in attempting to match demand for spectrum with frequencies. It is important, however, for regulators to not overlook the other important uses and user of spectrum: navigation and public safety, for example.

In Article 1 of the ITU Radio Regulations, the term "radiocommunication service" is defined as "a service…involving the transmission, emission and/or reception of radio waves for specific telecommunication purposes".

An example of radiocommunication service and related allocation issues follows in the next few paragraphs.

Mobile satellite services (MSS) refers to networks of communications satellites intended for use with mobile and portable wireless devices. The mobile-satellite service (MSS) includes maritime mobile-satellite service (MMSS), the land mobile-satellite service (LMSS) and aeronautical mobile-satellite service (AMSS). There are many important applications in the MSS including:

- Aeronautical Mobile Communications – global satellite phone service, distress and emergency services;
- Land Mobile Communications - global satellite phone service, distress and emergency services;
- And Ship borne or Maritime Mobile Communications – Inmarsat safety and communications services for maritime operations.

Telephone connections using MSS are similar to a cellular telephone link, except the repeaters are in orbit around the earth, rather than on the surface. MSS repeaters can be placed on geostationary, medium earth orbit (MEO), or low earth orbit (LEO) satellites, provided there are enough satellites in the system, and provided they are properly spaced around the globe, an MSS can link any two wireless telephone sets at any time, no matter where in the world they are located. MSS systems are interconnected with land-based cellular networks.

Services have proliferated and periodically allocations have been reviewed in an effort to harmonize allocations on both an international and regional basis. As well, several bands have been re-allocated to support the growth in terrestrial mobile services – IMT-2000.

One of problems facing MSSs is the relative success of terrestrial mobile services like GSM and Advanced Wireless Servicer in comparison to MSSs. There have been several significant attempts to bring widely based MSSs to consumers which have not lived up to the expectations of the business or consumer – (for example: Globalstar went into service in 1998 at a cost in excess of USD 4 billion and filed for bankruptcy in 2002 and the assets were ultimately purchased for USD 43.million). With these failures in the background, it has become a hot debate to reallocate spectrum to other expanding services. MSSs do have a fundamental advantage over terrestrial systems in that they can reach users practically anywhere. It is the prospect for advanced services to remote regions which continues to attract proponents for maintaining MSS allocations.

Recently, The European Parliament has approved a proposal that demands mobile satellite services reach at least 60 per cent of every country in Europe, and 50 per cent of their populations, in order to get operating spectrum. The ruling relates to a couple of chunks of spectrum which have been handed to the EU by member countries, for allocation to mobile satellite services on a pan-European basis. The spectrum is around 2GHz, specifically 1980-2010MHz for the up link and 2170-2200MHz for the down link, with no applicant being allowed to have more than 15MHz for each direction: thus specifying a minimum of two operators. To qualify for the spectrum those operators will have to reach every country in Europe, with reception possible in 60 per cent of each country's landmass, and by half of their populations.

The future of AMS(R)S primary allocations is on the agenda for WRC-11. WRC-07 agreed on a future Conference Agenda Item for WRC-11 to consider the results of ITU-R studies to ensure long term spectrum availability and access to spectrum necessary to meet the requirements for aeronautical mobile-satellite service in accordance with Resolution 222. For a more detailed look at the proposed WRC-11 agenda, See **Section 7.2.2 Recent ITU World Radio (WRC) and Regional Radio Conferences (RRC).**

Practice Notes

- **Industry Canada: Principles Applied to Re-allocating MSS Spectrum**
- **Radiocommunication Services - ITU-R Allocations for Mobile-Satellite Services**
- **Radiocommunication Services ITU Regulation**

5.2.6.2 FREQUENCY ALLOCATION TABLES

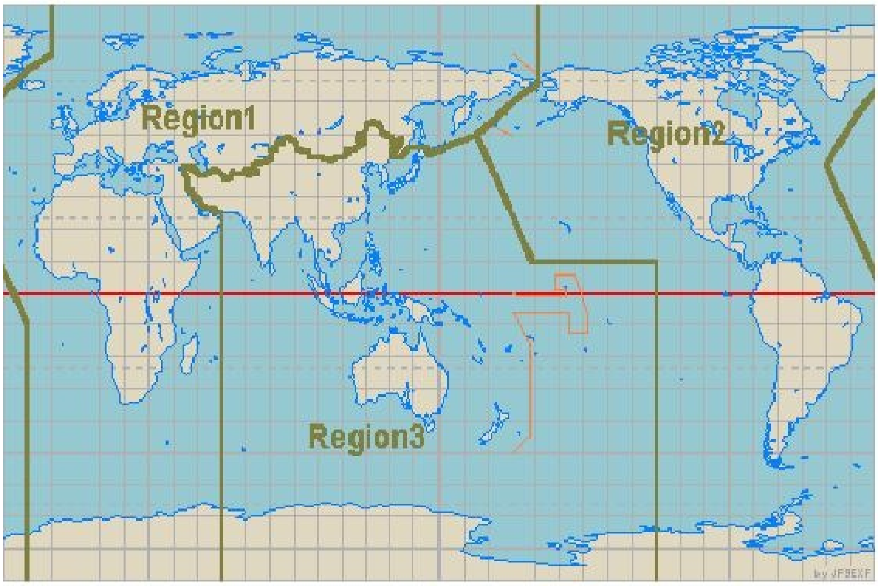
Before considering how the spectrum is allocated, it is perhaps best to clarify three terms: allocation, allotment and assignment.

An allocation is an entry in a table of frequency allocations which sets out the use of a given frequency band for use by one or more radiocommunication services. The term allocation is also applied to the frequency band concerned. An allocation then is a distribution of frequencies to radio services.

An allotment is an entry of a designated channel in a plan for use by one or more countries in those countries or within designated areas for a radiocommunication service under specified conditions. An allotment then is a distribution of frequencies to geographical areas or countries.

An assignment is an authorization given for a radio station to use a radio frequency or a radio frequency channel under specified conditions. An assignment then is a distribution of a frequency or frequencies to a given radio station.

For purposes of allocation, the world is divided into three Regions referred to as Regions 1, 2 and 3. A map indicating these Regions can be found below. A precise definition of the boundaries between Regions may be found in Article 5 of the ITU Radio Regulations.



◂ **Regions according to ITU Radio Regulations**

ITU-R

Allocations are made on a primary or on a secondary basis. Stations of a secondary service cannot cause harmful interference to stations of primary services to which frequencies are already assigned or to which frequencies may be assigned at a later date. Stations of a secondary service cannot claim protection from harmful interference from stations of a primary service to which frequencies are already assigned or to which frequencies may be assigned at a later date. Stations of a secondary service can, however, claim protection from stations of the same or other secondary service(s) to which frequencies may be assigned at a later date. In a given band of the Table of Allocations, there are often footnotes which allocate the band in question (or a portion of a band) only in a specified geographic area. When a band (or portion of a band) is indicated in a footnote 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. Where a band (or portion of a band) is indicated in a footnote 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 only in that area or country. The international Table of Frequency Allocations set out in the ITU Radio Regulations covers frequencies from 9 kHz to 275 GHz (or 1000 GHz, see footnote 5.565).

As mentioned in **Section 2.3.5** of this module, a National Frequency Allocation Table is an important document in planning the use of the spectrum within a given country. The National Table of Frequency Allocations must, in general, be consistent with the ITU Table of Frequency Allocations but usually contains a sub-set of the allocations found in the International Table. In addition, it usually is far more detailed and gives additional conditions for the use of spectrum usually through national footnotes in the National Table.

A recent example of modifications to Article 5 of the Radio Regulations involving significant changes to allocations across all regions are the IMT Advanced Allocations for Broadband Wireless Access (BWA) which have implications for most if not all members. These resolutions affecting the changes in allocation were made at the World Radio Conference (WRC) in Geneva in 2007. For a more detailed discussion of Recent World Radio Conferences see **Section 7.2.2**.

In this section, we discuss some of the step by step approaches involved in changing national frequency allocations to reflect and accommodate the changes in the International Table resulting from the WRC decisions concerning BWA.

Introducing New Services such as BWA – a general approach

Changes to the National Table of Allocations will ultimately lead to assignments for services. Allocations and assignments are linked and will ultimately reflect local market structures and conditions.

Allocating and assigning spectrum for various uses and users by regulators is a powerful tool with significant implications. Imposing or limiting restrictions on uses and users has a direct impact on spectrum access and efficiency. Knowing where and where not to impose restrictions requires information, building consensus and where consensus is lacking, the means to smooth out differences by way of an adjustment process such as compensation or arbitration. Consultation is important at all stages. Some of the general practical steps taken by regulators include:

- Acquiring the information needed to assess use, users and utilization. Spectrum audits can be performed to fill in the gaps in information;

- Consulting with current and prospective users;
- Creating channelling plans which compact spectrum assignments and increase the number of occupants through techniques such as re-use to ease congestion and interference;
- Reinforce the application of technical standards and compliance to ensure interference is managed and manageable;
- Clearing zones of spectrum through refarming incentives (user to user) or recapturing underutilized spectrum;
- Examining ways to license or unlicense underutilized spectrum to increase use and sharing;
- In bands where trading can take place and demand has been pooled, band managers can be tasked to manage use and users

Specific practical steps include the following:

- Identify the specific bands of interest and determine current use and utilization;
- Consult with existing and potential users and assess demand and value for existing and potential services;
- Conduct comparative analysis with relevant country experience and consider spectrum assignment, licensing and spectrum pricing issues and implications;
- Conclude on affected bands and consider allocation methodology. For example will 2 X 5 or 10 MHz chaired spectrum be allocated and in which bands;
- Consult and determine which allocation methodologies and authorization and assignment methodologies will be proposed or applied. The practice varies significantly across regions and methods include: administrative processes such as first-come first served, comparative review, auction methods. As well, concessions granted in the past may include unified service licenses (for more on authorisations see Module 3);
- Prepare resulting policies, plans and processes required to support conclusions on methodology, reallocation implementation steps, and expected assignment and licensing (unlicensed) outcomes.

Practice Notes

- **Europe – Frequency Allocation Tables**
- **Germany (BNETZA) - BWA Allocations and Auction**
- **Mauritius – BWA Allocations**
- **Mexico – BWA Allocations**

Reference Documents

- **A Proposal for a Rapid Transition to Market Allocation of Spectrum**
- **Kenya: Table of Radio Frequency Allocations, 2002**
- **Table of Frequency Allocations**

5.2.6.3 SPECTRUM USE DESIGNATIONS

In the international Table of Frequency Allocations as well as in national Tables, there are designations or identifications of spectrum use. These set out more specific types of frequency use than that foreseen in the allocation of a frequency or frequencies to a given radio service. For example, in the international Table, some bands allocated to the mobile service are designated for use by IMT-2000 systems. Such designations in the international Table do not preclude any use of the frequency band by the services to which it is allocated nor do they result in any priority for such use. At the national level, however, countries may choose to give such designations a priority or even use such indications to mandate an exclusive use within a given band. For example, a band allocated to the mobile or land mobile service may nationally be designated for a cellular mobile telephone service to the exclusion of all other mobile operations.

Practice Notes

- **ITU Radio Regulations – Article 1, Definitions of Radio Services**

Next: 5.3 Authorization ➡