Electronic Communications Committee (ECC)
within the European Conference of Postal and Telecommunications Administrations (CEPT)

REFARMING AND SECONDARY TRADING IN A CHANGING RADIOCOMMUNICATIONS WORLD

Messolonghi, September 2002

EXECUTIVE SUMMARY

SUMMARY OF THE REPORT

- This Report has aimed at providing deeper insight into the theory and practices of spectrum refarming. As such it could be used as a guide by Administrations on spectrum refarming and spectrum trading bearing in mind that the implementation of refarming and spectrum trading processes remains a strictly national issue.
- The Report has described the technical developments of the use of radio and has indicated how radiocommunications technology and use have changed during the recent decades. Furthermore the current regulatory regime including the EU package of Directives has been described.
- The main theme has been the introduction of refarming and secondary trading as a part of the overall spectrum management activities.
- In addition to the theoretical aspects of refarming the practical instruments of refarming and spectrum trading have been investigated and the current experiences and state of the art within CEPT countries and in non-CEPT countries provides an indication in which direction this issue will develop.
- It is expected that refarming of frequency bands involving some sort of forced withdrawal of frequency assignments might be a process that some countries may have to employ in the future, when frequencies have to be made available for the introduction of new radiocommunication services.
- Below is an overview of the conclusions on spectrum refarming, spectrum trading and on the current experience of CEPT countries:

CONCLUSIONS ON REFARMING, ADVANTAGES OF REFARMING

- The purpose of spectrum management is to give access to spectrum for the largest possible group of interested parties in due time, while ensuring the overall efficiency of spectrum use and avoiding harmful interference between the users. Refarming in the traditional sense means the recovery of spectrum from its existing users for the purpose of re-assignment, either for new uses, or for the introduction of new spectrally efficient technologies. As such refarming is a spectrum management tool that can be used to satisfy new market demands and increase spectrum efficiency.
- When new radiocommunication services are introduced or new spectrally efficient technologies replace older technologies this often occurs as a natural migration that does not cause noticeable problems to spectrum management authorities and hence does not require the use of specific refarming instruments. It could be expected that voluntary withdrawal in some countries will happen less often in the future because of different reasons, such as high sums that have been paid for the access to the frequencies, more and quicker frequency harmonisation processes that could be expected triggered by the new EU Frequency Decision.
- However, when refarming involves a forced withdrawal of existing frequency assignments and licensees, that is not in the interest of the incumbent user, then refarming may require application of a set of various refarming instruments, such as refarming funds, pricing incentives and secondary trading.
- Hence, refarming can be a process that requires the use of many different refarming instruments by the spectrum management authorities and there is, in the case of harmonised frequency bands, merit in harmonising refarming processes insofar as the decision to refarm and the timing of the process is concerned.
- When compensation of incumbent users is considered, the issues of subsidies and state aid have to be taken into account.

CONCLUSIONS ON SPECTRUM TRADING

- Spectrum trading is one of the frequency management tools, which might offer advantages of dynamic optimisation of spectrum distribution, including in the context of refarming.
- Spectrum trading is complementary to market-based spectrum pricing in the form of auctions or administrative incentive pricing and also to spectrum planning and regulation.

- There are several different variants of spectrum trading, which need to be carefully planned and selectively applied within a framework of regulation that is effective without being too cumbersome and in the light of national circumstances and objectives.
- Development of trading will be promoted by certainty about licensees' rights, including freedom from interference, security of tenure and expectation of renewal, and flexibility to change the use made of spectrum within the constraints of spectrum planning and international harmonisation.

CONCLUSIONS ON CURRENT EXPERIENCE OF CEPT COUNTRIES

A few general conclusions may be drawn from analysis of the replies:

- Refarming had been extensively used in CEPT already for some time, and various refarming tools are being employed both within a particular country as well as across Europe as a whole;
- From some of the replies it seems that many countries still do not have a clear methodical distinction between the various refarming tools, which in itself provides additional evidence for the need of the ECC Report on this subject.
- It seems that up to now the voluntary withdrawal of incumbent users was the most commonly used refarming option, with the refarming processes being still sufficiently quick in this case (2-3 years on average);
- The dominant use of voluntary withdrawal may explain the fact that most of the replying administrations considered their current legal regimes as being appropriate for handling the refarming cases;
- However some further indications were received arguing that voluntary withdrawal may no longer be suitable in the future, when quick refarming times are needed in highly congested spectrum portions. Then the question of appropriate legislation to handle more sophisticated refarming tools would naturally arise;
- Licence expiry appears to be a default option, but the refarming processes tend to take longer. Licence revoking is usually seen as a complementary (follow-up) measure together with the licence expiry;
- Compensatory mechanisms so far have not been widely used in Europe and spectrum trading was not allowed at all in most administrations, so further guidance from ECC on introduction of such financial (market-based) tools should be instrumental in promoting these novel mechanisms throughout CEPT.

PROPOSALS

Summarising the content and spirit of this Report, as well as the various conclusions made above, the following proposals could be suggested for future actions by CEPT:

- While refarming and spectrum trading are and will remain a strictly national issue, the widest possible harmonisation of refarming measures and in particular time scales for such actions should be considered wherever possible. This is particularly applicable to the cases, where the system to be introduced is intended for trans-national use and when the refarming or trading measures may have an impact on operation of radiocommunication services in neighboring countries;

- The introduction of spectrum trading has taken place in Europe only in a very limited number of countries and on a very limited scale (only trading that comprises change of ownership of a licence), but might be considered to be introduced more widely and with different modes, as it potentially would offer many benefits if, at least initially, applied in a selected frequency band(-s) and with carefully designed trading rules and environment.

- Whenever any one of CEPT administrations decides to implement certain novel or larger scale refarming or trading actions, it would be advisable to notify such intended actions through the normal CEPT channels. This would ensure that the possible international impact of such actions is carefully assessed and the experiences/know-how involved with such actions promoted through the rest of CEPT membership;

- Since it is expected that many administrations may start considering the introduction of secondary trading it might be advisable to continue study of this, via tasking a project team with the topic.

- Given the future expected developments in the area of refarming and spectrum trading, it could be suggested that this Report should be reviewed regularly, with the aim of reflecting those future developments and experiences gained.

INDEX TABLE

1 INTRODUCTION

1.1 Subject and purpose of the Report

Traditionally the need to change the use of frequency bands (broadly defined as refarming) was not a significant problem in the centrally regulated environment of the PTT era. The appearance of new systems was planned well in advance and necessary spectrum relocation provisions could be made reasonably effortless, usually as a natural migration of technology.

However, the complete change of regulatory environment in Europe over the last decade, brought about by liberalisation of the telecommunications and radiocommunications sectors, together with the advances in radio technology have led to an explosive growth in radio use. Demands for new services and applications, from unobtrusive and ubiquitous short range devices to sophisticated public mobile telephony and data networks, are ever growing and spectrum managers have difficulty in deciding which applications and/or services should be granted access to the parts of the radio spectrum most in demand.

The resulting congestion of the most attractive parts of radio spectrum and much shorter system life-cycles today often neither allows for finding suitable unused bands for new radiocommunication services nor achieving suitable sharing arrangements with incumbent services. Therefore the issues of deciding between services competing for the same spectrum and refarming of currently used spectrum for new systems are increasingly faced by the spectrum managers. Market related considerations, such as ensuring competition and satisfying the customer needs were not always of prime consideration in centrally planned approaches, but today become of high importance.

It is therefore expected that because of these developments in radiocommunications market, refarming of frequency bands will be a process that some countries may have to employ more often in the future, than hitherto. It will also become more difficult to carry out because of the increased congestion and competition for spectrum, as well as the shorter time scales available for such actions and additionally, because of increasing awareness of spectrum value (in particular after the recent auctions of spectrum for UMTS/IMT-2000).

This Report therefore aims to provide deeper insight into the theory and practices of spectrum refarming and as such is expected to be used by Administrations as a source of guidance on this subject.

In the preparation of this Report it became obvious, that the issues of secondary trading and convergence, even if having their own distinct purposes and tendencies, may play a role in assisting the refarming processes in certain circumstances. Therefore spectrum trading and, to a lesser extent, convergence have also been covered in this Report, in particular with regard to their relationship with spectrum refarming.

While the Report is intended as guidance on the application of spectrum refarming and trading, it is however realised that the implementation of refarming and spectrum trading processes remains a strictly national issue. As such their use depends fully on the legal bases and regulatory practices in the area of spectrum management in a particular country. This was something that was also emphasised in the reactions that were received from administrations and organisations after publication of the DSI III report[1], which among many other things also gave some recommendations in the area of refarming.

Therefore without recommending any particular way, the Report aims to highlight the different issues surrounding refarming and the influence that secondary trading and convergence will have. The Report gives information and guidelines for Administrations to consider now and in the future. It also gives an overview of the current developments and experience within the CEPT Administrations in the area of refarming.

The related developments within the ITU and non-CEPT countries (Canada, USA, other) in the areas of refarming and secondary trading were also considered while developing this Report.

On the regulatory side, the Report as well considers what influence the new EU Electronic Communications regulatory package (2002) might have on the subjects covered in this Report.

[1] The ERC (predecessor of the ECC) has agreed to use the Detailed Spectrum Investigation (DSI) process as a means to achieving forward planning and harmonisation of the radio frequency spectrum in Europe. Three DSI processes have been carried out by the ERO, namely the DSI Phase I covering the frequency range 3.4-105 GHz, the DSI Phase II (29.7-960 MHz) and the DSI III (862 - 3400 MHz).

1.2 Structure of the Report

The Report starts by describing in **Chapter 2** how radiocommunications technology and use have changed during the recent decades and the Chapter gives an overview of the major new technical developments, which will influence the use of the frequency spectrum in the coming years. **Chapter 3** describes the current regulatory regime, including the EU package of Directives published in the first quarter of 2002 as a follow-up of the 1999 Telecommunications Review and describes other international regulations, relevant to the subject. **Chapter 4** introduces refarming as a part of overall spectrum management activities.

Following this general positioning of the subject within the radiocommunications area, the report continues with a detailed review of the theory of refarming in **Chapter 5**. **Chapter 6** highlights the topic of State aid and subsidy, which need to be taken into account when incumbent users are compensated during refarming processes. **Chapter 7** is devoted to the theory of spectrum trading.

Following these theoretical chapters, the remaining parts of the report are largely devoted to practical applications of refarming and spectrum trading. **Chapter 8** describes current experiences and state of the art within CEPT countries, while **Chapter 9** summarises some of the experiences in non-CEPT countries with trading. The report concludes by giving conclusions and proposals in **Chapter 10**.

2 CHANGES IN THE USE OF RADIO

2.1 Nature and pace of changes

As already briefly mentioned in the introduction, the use of radio spectrum is ever changing. However recently changes in the radiocommunications sector have become more complex, dynamic and harder to foresee.

For a long time remaining a closed area of carefully planned professional applications and corporate users (such as military, governments, utility companies, etc.), the world of radiocommunications first received a serious public boost during the 1980-ies, when the first generation of public mobile telephony networks was introduced. Since then radiocommunications has become a highly visible part of the telecommunications industry, quickly gaining subscribers, attracting significant investments and pushing applications and technology forward. Given the wide acceptance and high interest from broad user groups, the mobile technology quickly advanced, producing lightweight user terminals and further widening applications to a broad range of digital services.

Although there has been a downturn in the telecoms market in past two years, generally over the last decade the radiocommunications mass-market became a vibrant and dynamic marketplace, where new applications are leading to demand for yet other new applications and this is expected to continue to be so in the long term. All these changes also incur additional demand for spectrum, and it becomes clear that recognition of the driving factors behind those changes and developing the ability to prepare for them are important steps in developing a spectrum refarming strategy.

Therefore the remainder of this Chapter addresses some of the major factors that drive the changes in today's radiocommunications market. To recognise the changes and assess their likely consequences on a national level is a difficult task, but applying modern management techniques may significantly ease this task. One of such techniques, called Scenario Management is described in one of the Annexes of the Report.

2.2 Institutional and legal changes

One of the most important factors driving the recent and future changes in radiocommunications market is the institutional and legal background. Originally the radiocommunications were managed within the framework of the state-owned PTT monopolies, which often were also the main operator of quite limited public radiocommunications services at the time. The changes in the use of radio at that time were carefully projected and centrally managed. This has significantly changed by the divesting of PTTs and liberalisation of radiocommunications markets, which was completed in most European countries by the beginning of 1990-ies. This resulted in the appearance of many private radiocommunications operators and booming growth of public radiocommunications services.

Following the initial experience of liberalised radiocommunications markets many European countries have totally revised their telecommunications legislature and often adopted new telecommunications and radiocommunications laws in the mid

1990-ies. This was usually aimed at ensure the efficient functioning of a liberalised market and the establishment of a new regulatory structure with independent National Regulatory Authorities in the centre of telecommunications management.

This second phase of liberalisation is now being followed by the third phase of moving towards a self-regulating telecommunications market. These changes were initiated following the EU Telecom Policy Review in 1999 and have been heralded by the adoption in early 2002 of the new package of EU Telecom Directives. The importance of the role of radio spectrum policy in this activity was also recognised through the adoption of the EU Radio Spectrum Policy Decision, which institutionalised some of the main policy provisions in this area.

Another area of recent major institutional and legal changes in the area of radiocommunications was the deregulation in the area of conformity assessment. This was accomplished by the adoption in the EU of the Radio and Telecommunications Terminal Equipment (R&TTE) Directive, which made provisions for abolishing most of the traditional "a priori" market control and ensuring the free movement of most radiocommunications equipment on the European market.

2.3 Technical changes

Since the start of cellular technology in the first generation public mobile networks, radiocommunications has moved from a technology used for a limited number of services and people to a mass market technology. This development has brought about a lot of innovation, research and development into the field, resulting in an endless stream of technological advances.

Together with technology developments, the standardisation activities also took off, giving yet another boost for development of mass applications. A good example of this is the success of the GSM standard developed by ETSI around the year 1990.

Technology changes are difficult to predict by themselves, but it seems even more difficult to predict the time scales for commercial deployment of the emerging technologies (e.g. recent delays with the deployment of UMTS/IMT-2000). This places particularly high pressure on spectrum management, because a priori spectrum availability is usually demanded and seen as a necessary guarantee for investing into the development of new technologies. At the same time, the advance freeing of spectrum may lead to inefficiency if the new technology arrives later or does not arrives at all. This once again reinforces the need for inherent flexibility of future spectrum management decisions.

One innovation, which is still in its infancy, but when properly developed may significantly change the fundamental spectrum management assumptions and rules is a so-called Software Defined Radio. This concept aims at fully re-configurable radio equipment, which could be adjusted to operate in a different frequency band, with different parameters, with different network technology by a simple adjustment of their internal operating software, either in a service shop or just automatically by receiving instructions over the network. Once developed, such devices could alleviate many of today's spectrum management (and in particular spectrum refarming decision-making) considerations, linked to the currently very limited flexibility of operating radio equipment.

2.4 Market issues

As already explained in the previous sections, during the last decade radiocommunications have been developing in a liberalised environment of a market-based economy. This resulted in the influence of market-driven considerations and tendencies on the daily practice of the radiocommunications sector.

So today most developments in the field of radio technologies and services are driven by the demand from end users and industry itself. And since radiocommunications became an integral part of peoples' daily lives, the demand is increasingly difficult to predict, as it is very much inter-linked with many other societal developments. Therefore the radio technology now attempts to follow any changes in the user base structure and their behavioural patterns. That is why manufacturers are constantly striving to adapt by observing trends in interests in particular applications (increased SMS use, web browsing, transmission of music files, multimedia) as well as issues of pure fashion (size and design of the terminals, which impacts their radio parameters as well).

Radiocommunications has also become a strong macro economic force in the national economies. Therefore any changes facing the industry, e.g. withdrawal of a particular radiocommunications service due to refarming, may be either eased or hardened by such related macro economic issues as employment, capital interest rates, industry growth, etc.

2.5 Convergence

Convergence in the broader sense means the fusion of different telecommunications and information technologies in order to provide the end customer with the broadest possible range of services and applications, often accessible from one terminal. An example is the combination of public calling capabilities (telecommunications) with the reception of video and audio programmes (broadcasting) and remote computing (information technology), all manageable from a single (so-called multimedia) terminal.

From the technology standpoint convergence means that the range of traditional service-tailored connections (e.g. telephone line, broadcasting channel, computer access in the above example) should be replaced by a transparent bit stream of flexibly adaptable bandwidth. While the modern telecommunications networks already realise such transparent transmission of bit streams between the network termination points, most highly divergent radio access technologies are ill-suited for the provision of such transparent and flexibly re-configurable bit streams between an end user and a network termination point.

Traditionally, radio spectrum was allocated to particular services (e.g. broadcasting, mobile, fixed, etc.) and the radio networks developed within those allocations were subsequently tailored for specific use (e.g. one-way wideband broadcasting networks, two-way narrowband mobile networks, fixed connections with strictly defined bit stream parameters, etc.). The current pattern of spectrum use still reflects those parameters (channel width, duplexing set-ups, etc.) of the particular networks/applications. Therefore convergence is now likely to demand from spectrum managers two major efforts: to review the principles of allocating spectrum to particular services and to re-arrange the existing spectrum use by adapting it to provisioning of transparent application-independent connectivity.

3 REGULATORY CONTEXT

3.1 National regulations in CEPT countries

It is clearly recognised that refarming and spectrum trading remain essentially a matter of national choice, which should result in the adoption of the appropriate national regulations. The national regulations should therefore provide a legal basis for refarming measures.

Following the recent general liberalisation of the telecommunications market, most European countries have adopted modern telecommunications and radiocommunications laws, allowing for spectrum refarming tasks either through specific provisions in the law, or through a general remit to ensure efficient use of spectrum. It appears that spectrum trading was up to now not used in European countries, although some of the national telecommunications laws permit it.

The questionnaire issued in the context of this Report with the aim to collect information about the experiences of different CEPT Administrations in the area of refarming allowed also to have a glimpse on the specifics of current national regulations. The replies are summarised in **chapter 7** and more detailed overview is given in **Annex 2** of the report.

It may be concluded that refarming is normally carried out nationally, based on the laws and regulations set out in a particular country. However it should be also noted that spectrum refarming and trading, as spectrum management tools have a much wider international implication. The following sub-sections provide some of the information related to this.

National rules about refarming and spectrum trading should take into account the international context dealing with spectrum use and management.

3.2 International Telecommunication Union (ITU)

The agreements binding the Member States within the framework of ITU lay the foundation for spectrum management world-wide. ITU international agreements recognise that utilisation of the radio frequency spectrum is a matter of State sovereignty. However, in order to be efficient the use must be regulated and therefore this sovereignty should be given a framework. The basic global instruments by virtue of which States undertake to respect common rules for sharing and using the spectrum constitute this framework. The goal being efficient utilisation of spectrum and equitable access.

The ITU instruments, at least those that are relevant to spectrum management, are the Constitution (CS), the Convention (CV) and, most important, the Radio Regulations (RR). These instruments are only binding the States and are therefore not directly applicable to individuals, operators or others, concerned by spectrum utilisation. Compliance with those

instruments therefore presupposes that each State will take the measures required (legislation, regulations, clauses in licences and authorisations) to extend those obligations to other spectrum users (operators, administrations, individuals, etc.).

The principle underpinning most of the provisions of ITU Radio Regulations is set out in No. 4.3, which stipulates that any new assignment (i.e. any new authorisation to operate a radio station) must be made in such a way as to avoid causing harmful interference to services rendered by stations using frequencies assigned in accordance with the Table of Frequency Allocations and the other provisions of the Radio Regulations, the characteristics of which are recorded in the Master International Frequency Register (MIFR).

In particular, a new assignment can only be recorded in the MIFR after completion of a procedure (for instance, Articles 9 and 11) aimed at ensuring that it will not cause harmful interference to assignments made in accordance with the RR and previously recorded systems.

The ITU has recognised the importance of refarming as one of spectrum management tools through the adoption of study question ITU-R Q. 216/1 ”Spectrum redeployment as a method of national spectrum management”. Another ITU-R question, which is closely relevant to the subject, is ITU-R Q. 206/1 ”Strategies for economic approaches to national spectrum management and their financing”.

Both of these questions are currently under consideration by the ITU-R SG1 (WP1B) and are expected to result in adoption of relevant ITU-R recommendations, to be completed by the end of study period 2000-2003. In July 2002 WP1B has produced the draft new ITU-R Recommendation ”Spectrum redeployment as a method of national spectrum management” in response to question 216/1.

The proposed draft new recommendation gives a definition of spectrum redeployment (also referring to it as spectrum refarming) and discussed several issues, surrounding the redeployment of spectrum. Among those are several redeployment scenarios and several cost recovery models. In particular it mentions that such principles could be applied to redeployment of fixed services from the 1-3 GHz range, to support introduction of new advanced mobile telecommunications systems. This draft recommendation is tentatively scheduled to be adopted by SG1 by correspondence during 2002/3.

3.3 Regional harmonisation

3.3.1 Recent CEPT initiatives on the subject

For some time, CEPT has been developing harmonisation measures in the area of novel approaches to spectrum management, such as application of economic measures. Recognising the principal sovereignty of member states in carrying out such measures, studies and resulting recommendation of certain "good practice" approaches in the form of ERC/ECC Reports were considered to be the most appropriate harmonisation measures in this area. Two prior examples of the work are ERC Report 53 on the introduction of economic criteria to spectrum management and principles of fees and charges for spectrum use, and ERC Report 76 on the role of spectrum pricing.

This Report follows in the same track and was initiated based on the results of the DSI III[2] process, where it was suggested to develop guidelines for refarming and a discussion document was produced. The ERC has accepted the DSI proposals on refarming, which means that the development of this report has started, taking account of the following DSI Phase III conclusion:

> “It is recommended that the ERC should recognise that the refarming process is a national issue but that redeployment of spectrum has also bilateral and multilateral aspects. The ERC should study and review the refarming process in Europe. The work would need to take into account the very different legislative background for refarming in Europe.
>
> That the ERC should collect information and develop guidance for administrations on economical aspects of frequency management and refarming including the following issues:
>
> - The economic value of the access to the frequency spectrum for users;
> - Cost recovery of refarming;
> - Milestone review procedures or similar adaptive procedures should be introduced to control refarming of spectrum in a timely manner;
> - The establishment of refarming funds combined with long term planning of the use of the spectrum in support of refarming;

[2] Detailed Spectrum Investigation III, which studied the bands 862-3400 MHz. DSIs are a means to achieving forward planning and harmonisation of frequencies.

- That industry should be invited to participate in this work.

That this work should be initiated as soon as possible as an ongoing process and that reporting from the work should be prepared before the year 2002 prior to the planned implementation of the first phase of UMTS/IMT2000."

3.3.2 Developments in the European Union

The European Commission in its Green Paper on Radio Spectrum Policy (1998) posed the question to what extent a harmonised Community approach is needed to develop and implement refarming policies as part of spectrum management, in particular with regard to the phasing-out of analogue broadcasting and mobile telephony services.

The CEPT response to this Green Paper offered the opinion that "refarming is a strategic issue, as it is a tool for long term strategic planning. It has international connotations, as it is the technique used to harmonise spectrum utilisation; but how to implement a decision to make available specific frequencies is a matter for each national administration to decide".

Most other respondents to the Green Paper were also of the opinion that refarming is a strategic management tool. For European services, harmonised decisions on frequency allocations should be taken, but the majority view was that because of national differences between the countries, refarming should be carried out on a national basis, although a European policy or guidelines might be established. Many respondents emphasised the importance of an open dialogue with the users of the spectrum before taking any refarming decisions and emphasised that refarming decisions should be market led. Some respondents mentioned the importance of using the instrument of sharing and using the element of time to the utmost. A number of respondents were of the opinion that the EU could have a political role in the process or could contribute by making the necessary funds available.

Following this and other consultations carried under the general title of EU Telecommunications Review (1999), the Commission developed a set of proposals, which resulted in final adoption at the beginning of 2002 of a complete package of new EU legislation in the area of electronic communications. The package consists of a so-called Framework Directive and 5 other associated Directives (Access and Interconnection; Authorisation; Universal Service; Data Protection; Competition Directives), together with regulation on local loop unbundling and a Radio Spectrum Policy Decision.

It should be noted that none of these regulatory acts addresses the issue of spectrum refarming specifically endorsing the view that it is a purely national matter. However the Radio Spectrum Policy Decision *inter alia* calls for most efficient use of spectrum resources and advises national administrations when taking spectrum management decisions to take due account of economic and other non-technical issues in the same manner as traditional technically based considerations.

The Framework Directive is more specific in so far as it is the first time in Europe that official recognition of spectrum trading is made. Recital (19) notes that "Transfer of radio frequencies can be an effective means of increasing efficient use of spectrum, as long as there are sufficient safeguards in place to protect the public interest, in particular the need to ensure transparency and regulatory supervision of such transfers". Accordingly, article 9.3 allows member states to make provisions for transfer of right for use of radio frequencies between the undertakings and article 9.4 makes basic provisions for rules to be associated with such transfer.

Thus the Framework Directive paves the way for national administrations to consider whether spectrum trading is appropriate for their national spectrum management system and sets some necessary legal basis for implementing it.

The Authorisation Directive, which supplements the Framework Directive also addresses the use of frequencies, however no specific references to spectrum trading or refarming are made. The directive retains the right of administrations in the member states to attach appropriate restrictions to the use of frequencies, including designation of service or type of network or technology services, including also the exclusive use of frequencies for the transmission of specific content or specific audio-visual services.
This means that again the issues such as convergence (implying service-neutral allocation of frequencies) are left to the discretion of administrations to decide on a case by case basis.

In addition to the legislation on electronic communication services, the EU has adopted the Radio and Telecommunications Terminal Equipment Directive (R&TTE), making the free circulation of such equipment mandatory, provided that it complies with relevant essential requirements. The Directive also imposes transparency and the publication of information on radio interfaces and national frequency allocation tables. Although R&TTE applies only to equipment, it has a definite impact on spectrum management, imposing a high degree of harmonisation among EU countries.

3.4 Radiocommunications Sector Organisations

There are several specialised international organisations in the field of radiocommunications, which have an impact on the way their specific radiocommunication services are used. For example, the International Civil Aviation Organisation (ICAO) establishes technical rules and conditions for the radiocommunication services and equipment used on board aircraft and for air traffic control purposes. Similarly, the International Maritime Organisation (IMO) establishes conditions and technical requirements for some of the safety related naval radiocommunication services and equipment.

Another similar international organisation with the impact on standardisation and regulation of the way radiocommunications are used are such as the WMO (meteorological services), IARU (radio amateur services), IAU (astronomical services), NATO (military services), EBU (European Broadcasting Union), etc.

Strictly speaking, these organisations have no direct responsibility for authorisation aspects of radio equipment use (i.e. licensing, fees, etc.) that remains the strict national sovereign right of their member countries. However their technical standardisation work and recommendations to use specific types of equipment for specific purposes in specific frequency bands might have to be considered in some refarming exercises.

3.5 The World Trade Organisation (WTO)

The General Agreement on Trade in Services (GATS) recognises the sovereign right of member states to regulate, and to introduce new regulations, on the supply of services within their territories in order to meet national policy objectives. That right is nevertheless limited by Article VI and other relevant GATS provisions, notably in terms of transparency and timing.

GATS applies to the national spectrum management process and to the attribution of licences. As stipulated in Article VI, the sovereign right of each WTO member to manage frequencies must be administered in a "reasonable, objective and impartial manner" and should not nullify or impair specific commitments.

The members who have made an additional commitment under the Reference Paper on regulatory principles are bound by that text, which stipulates that when it comes to allocating scarce resources, the procedure followed must be objective, timely, transparent and non-discriminatory. GATS nevertheless recognises that spectrum management policy, if implemented in conformity with that provision, does not of itself constitute a hidden barrier to trade.

The implications of the WTO obligations effectively mean that countries may only in exceptional cases prescribe specific technology in their licences (authorisations for spectrum use), in order not to prohibit competition on technology level, in particular between competing standards from different regions of the world. However WTO obligations do not restrict the right of states to prescribe a particular service to be provided within the spectrum authorisation (e.g. public mobile telephony, etc.).

4 REFARMING AND ITS ROLE IN SPECTRUM MANAGEMENT

4.1 Goals and functions of spectrum management

Spectrum management is a complex process, carried out at a national and international level by specifically designated authorities, usually known as National Regulatory Authorities (NRAs). Radio spectrum as such is a precious, although reusable natural resource and the ultimate goal of spectrum management is to give access to spectrum for the largest possible group of interested parties in due time, while ensuring the overall efficiency of spectrum use and avoiding harmful interference between the users.

The fulfilment of this complex task might be possible only by applying a specific blend of tools of different origins: primarily engineering, but then (and increasingly so) general regulatory, competitive market, financial and political measures.

In their daily practices NRAs operate within a number of specific aims and objectives for management of the radio spectrum. These will reflect national policy and may e.g. favour public use or private enterprise. Stability in national policy is important to spectrum users for investment decisions. These policies and objectives will, inter alia, determine the shape of the spectrum management authority within the available resources and legislative requirements.

The main functions of spectrum management are:

1. Development of spectrum management policy and planning/allocation of spectrum;
2. Daily frequency planning, assignment and radio authorisations (Radio Licences);
3. Development of technical standards, specifications and conditions for use of frequencies;
4. Enforcement: market surveillance, inspections and spectrum monitoring;
5. International co-ordination of frequencies and long-term harmonisation of frequency use.

In this context refarming may be seen as a tool, used by the spectrum management policy and frequency planning functions of the NRA, whenever it becomes necessary to recover spectrum from existing users for the purpose of different use (re-assignment). The next sub-sections describe refarming and show the function of refarming in a typical cycle of spectrum management.

4.2 Essence of refarming as a part of the spectrum management process

Refarming is a spectrum management tool, which can be used to cater for new market demand, increase spectrum efficiency or work towards international harmonisation of spectrum usage. Refarming in its traditional meaning involves the recovery of spectrum from its existing users for the purpose of re-assignment, either for new uses, or for the introduction of new spectrally efficient technology.

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.

A few examples of various refarming processes are shown in **Figure 1**.

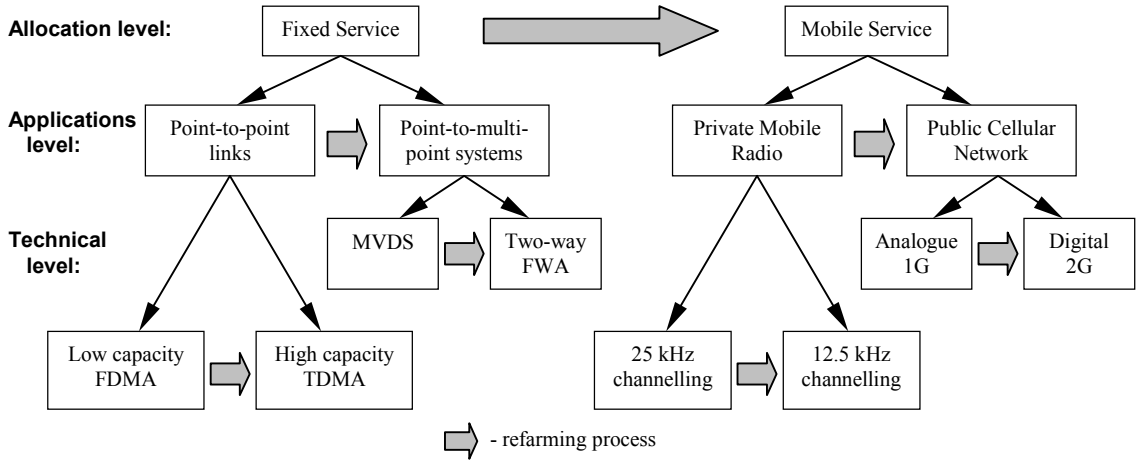


Figure 1: Examples of general refarming processes at different levels[3]

Most of the refarming processes, as suggested in Figure 1, are taking place as a natural migration, usually from older obsolete technologies towards the newer more advanced ones. In those cases refarming is either in the interest of incumbent users of frequency bands or incumbent users leave that band with removal of their old systems (e.g. upon cessation of licence duration in the absence of further demand). In both of these cases refarming will, in most cases, not cause noticeable problems to spectrum management authorities and therefore the use of incentives or other refarming measures will not be necessary in most cases.

It is when refarming involves some forced removal of existing frequency assignments, not in the interest of the incumbent user, when the refarming becomes problematic and requires application of a number of specific refarming measures, such as refarming funds, pricing incentives, etc. It is expected that the last mentioned refarming processes would need to be performed more often in some countries in the future and will also have to be performed within a shorter timeframe. It is therefore the kind of "forced" refarming, which is the main subject of this Report.

[3] MVDS= Multipoint Video Distribution System, FWA= Fixed Wireless Access, FDMA= Frequency Division Multiple Access, TDMA= Time Division Multiple Access.

4.3 Definition of refarming

The previous sub-section demonstrated how wide the definition of refarming could be, covering varieties of changes of use conditions for a given frequency band. It is also arguable whether refarming can only be performed by the spectrum management authorities or also by the market.

Various definitions of refarming have been developed in that respect, for example in previous ERC Reports, such as ERC Report 53[4] and 76[5], in a draft Recommendation of the ITU-R[6] and by individual administrations[7].

Refarming is seen as a broad process, which can occur in many different ways and in which secondary trading can also play a part. Therefore it can be noted that refarming as a process is not only performed by the spectrum manager, but also by the market. It seems however obvious to demand that any change in frequency use of a band should be reported and approved by the frequency management authority, in order to guard the effective use of the frequency spectrum.

Taking all those considerations into account, the following definition of refarming is assumed for the purposes of this report (see **Figure 1** for illustration of the refarming concept):

Spectrum refarming (redeployment) is a combination of present and future administrative, financial and technical measures within the limits of frequency regulation in order to make a specified frequency band available for a different kind of usage or technology. The measures may be implemented in the short, medium or long term.

4.4 Refarming in the spectrum management cycle

Spectrum management activities may be simplistically seen as a set of many parallel projects, each addressing how to fit in some specific case for spectrum demand from new or evolving radio systems within current and foreseen plans for spectrum use. Those projects normally develop through series of subsequent steps, making up what may be called a spectrum management cycle. A place of refarming processes in a typical spectrum management cycle is illustrated below in **Figure 2**.

The example given in **Figure 2** highlights that refarming often[8] is a “last-thought” option of spectrum management, because it is likely to cause the most problems to set up and usually is the most lengthy to implement. Therefore the option of spectrum sharing, that is co-location of old and new uses or radiocommunication systems within the same frequency band, is perceived as a natural preference and will always be extensively considered first. If not workable in a first instance, it might be re-considered with amended operational requirements and system parameters for a newcomer.

If co-frequency sharing is not feasible, a solution may be found by applying some kind of frequency separation, e.g. by using the interleaved channels for incumbent and new PMR-like services.

However sharing might not always be feasible and use of refarming might become an option. In such cases, the spectrum manager will have to evaluate whether refarming is absolutely necessary, e.g. whether the identified spectrum demand may not be accommodated elsewhere and, if not, whether introduction of newly proposed use or radio system will provide sufficient benefits to justify the refarming.

---

[4] ERC Report 53 on the Introduction of economic criteria in spectrum management and the principles of fees and charging in the CEPT (1998) described refarming as "a spectrum management function and the physical process by which a spectrum management authority recovers spectrum from its existing users for the purpose of reassignment, either for new uses, or for the introduction of new spectrally efficient technology. Resolution of all spectrum refarming issues is necessary before the spectrum planning process, to which it is linked, can be successfully completed. Spectrum refarming commences once a frequency band has been identified for redevelopment and firm proposals exist to either remove the existing occupants, or restructure the band plan. It is completed when the existing users have agreed to the changes and any associated preconditions to that agreement (e.g. co-ordination in a replacement frequency band) have been successfully concluded". This definition is taken over in ERC Report 76.

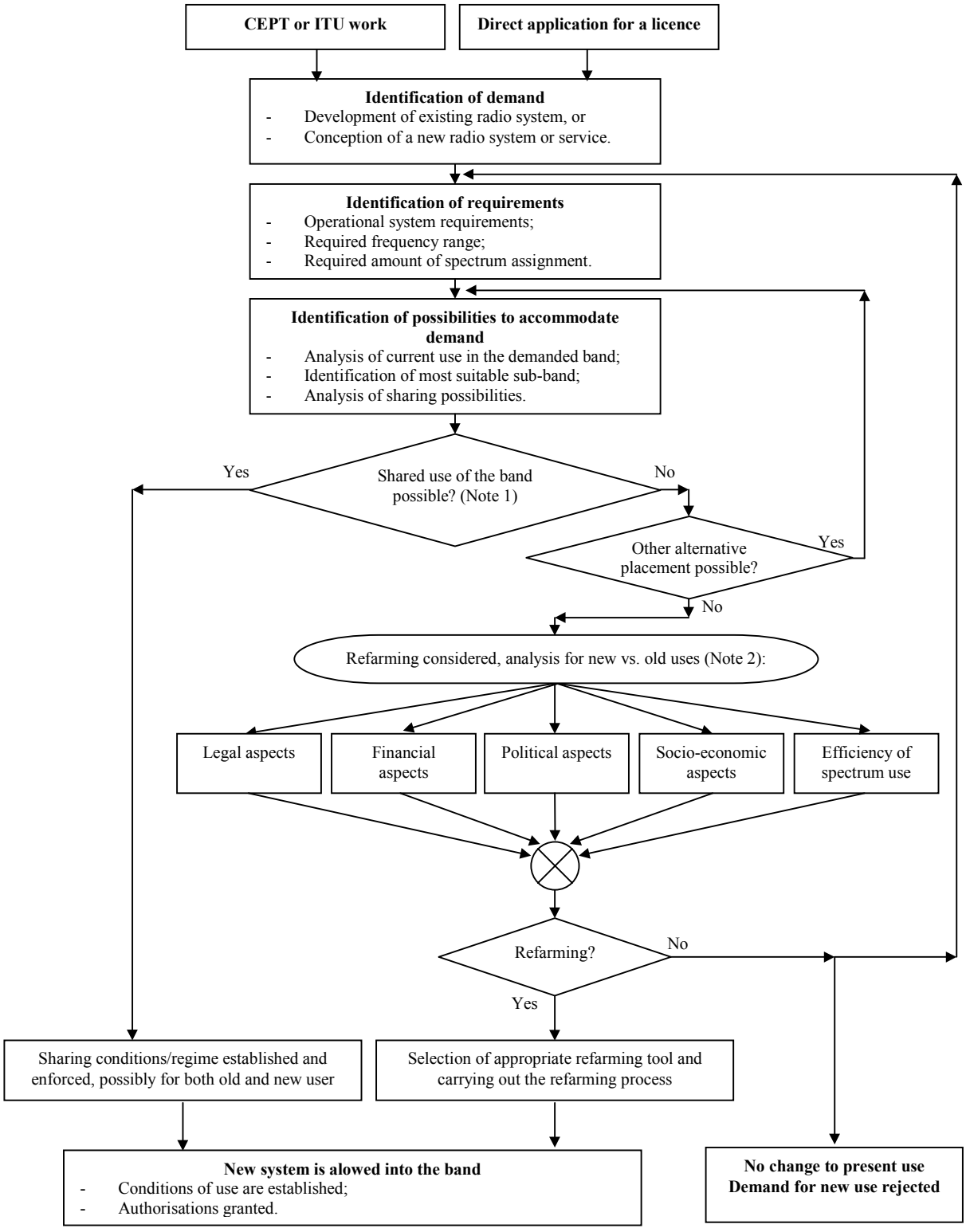
[5] ERC Report 76: The role of spectrum pricing as a means of supporting spectrum management (1999).

[6] Spectrum redeployment (spectrum refarming) is a combination of administrative, financial and technical measures aimed at removing the existing frequency assignments either completely or partially from a particular frequency band. The frequency band may then be allocated to the same or to different service(s). These measures may be implemented in short, medium or long-time scales.

[7] Germany: Refarming is the application of present and future instruments within the limits of frequency regulation in order to make a specified frequency band available for a different kind of usage.

[8] This reasoning leaves aside the situation that administrations can decide to stop the use in a certain band because of different reasons, such as old technology, too little use etc.

The prospect of having refarming as an ever present instrument in a spectrum management toolbox also suggests that other spectrum management decisions should be weighted in terms of whether refarming might be eventually foreseen for the band in question or not. For example, if refarming of a particular band might be expected soon, it would be unwise to allow licence exempt use of that band in the meanwhile. In such case, the licence exempt use would mean that no records on operational transmitters (their locations and principal number) would be known, thus meaning more difficulties for implementing refarming at a later stage.



Note 1: For definition of sharing, please refer to ITU-R Rec. SM.1132

Note 2: Such analysis could be assisted by application of scenario planning methodology, as described in **Annex III** of this report

Figure 2: Refarming in a traditional spectrum management cycle

5 REFARMING PROCESS

5.1 Introduction and structure of the Chapter

Fundamentally, when a frequency band is subject to refarming two successive steps can be identified. First, the decision whether to start refarming or not has to be taken. Second, if the first decision is positive, the most appropriate instrument in order to implement refarming has to be chosen.

Each of these two steps is singled out in each of the two lines of the matrix below. The columns show the initiators of a refarming process, which can be either the administration or private entities. Accordingly, the differences between the centrally decided refarming and internal market-driven refarming can be recognised.

	Administratively (NRA) managed refarming	**Refarming through spectrum trading(*)**
Triggering pconsiderations	*Legal criteria* *Financial criteria* *Political criteria* *Socio-economic criteria* *Technical and efficiency criteria* **Overall analysis performed and decision taken by a public authority(-ies)**	*Business criteria* *Financial criteria* **Analysis performed and decision taken solely by the owner of frequency use rights (**)**
Refarming tool selection* **	*Incentive pricing of spectrum use* *Licence termination (upon expiry)* *Voluntary withdrawal* *Compensation to incumbent* *Equipment re-tuning* *Other…*	*Contract between private entities (**)*

Notes:
* - if spectrum trading is enforced and conditions of frequency use may be changed within certain limits set by the government;
** - may be subject to approval by the administration (NRA);
*** - not in the order of preference

Figure 3: Comparison of administratively and privately managed refarming processes

It is worth mentioning that one possible case of refarming is not represented in this table. It is the case where the refarming process is not centrally managed by a spectrum management authority and where there is no change of ownership of the spectrum licence. Accordingly for the incumbent spectrum use and for the new spectrum application the licensee remains the same. This could for instance be in the case of a natural technology upgrade, which does not contradict the conditions of the original licence.

As will be seen in **Chapter 5.2,** administratively managed refarming is normally triggered if at least the following three basic conditions are fulfilled:

1) Neither sharing[9] nor suitable alternative bands allow for the accommodation of the radiocommunication application for which access to the spectrum has been requested (i.e. access to the spectrum will have to be granted at the expense of an existing application);

[9] What is also considered to be refarming according to the definition mentioned elsewhere in this Report, is the situation that the spectrum management authority decides to refarm a certain band because of the fact that the service to which the band is assigned does not take up and therefore it is decided to introduce other use in the band in question. A recent example is the band 169.4-169.8 MHz that was assigned to the ERMES paging service, which was hardly implemented in Europe and therefore it was decided to refarm the band.

2) The new use (system) requesting access to the spectrum is considered more valuable or more spectrum efficient than the present use;
and
3) It is considered worthwhile from political, legal, economic, technology, etc. points of view that the incumbent use (system) is moved out of the subject band.

It can be said that in the case of administratively managed refarming the spectrum management authority must choose the instruments of the refarming process according to the legal, economical framework conditions existent in the country. Indeed among the instruments at the disposal of the authorities to carry out the refarming process some instruments are more suitable than others according to the financial means at disposal, the time-frame set for the process, etc. (**See Chapter 5.3.5**).

On the other hand, if the necessary framework conditions are set by the government, refarming could also be implemented by private entities. The decision-taking process in this sector will rely uniquely on financial and business management considerations. Evidently, the costs of such a refarming process and the likeliness and the promptness of the return on the investment to be made will be crucial. Because the interests weighed when refarming is privately managed do not include abstract public interests, the framework conditions of such a refarming process must be carefully designed and set up by the administration on a formal basis. In particular in the case of spectrum trading, this would describe how trading might be performed and in exactly what way the conditions of use may be changed by the new owner of frequency rights. This point is considered in more details in **Chapter 6** dealing with spectrum trading.

In the case of refarming undertaken by private entities, the entity interested in part of the, to be refarmed, spectrum cannot introduce any constraining measures (even in the case of overlay licenses, the licensee only has a *right* to use the spectrum after a certain interval, but does not have the power to enforce this right – force remains the monopoly of the State). It can only rely on negotiated solutions in its relationship with the incumbent user of the spectrum. Vacation of the band by the incumbent user(s) will generally be the result of some positive incentives given to the incumbent. These agreements will be formalised in contracts.

5.2 Triggering refarming when the process is managed by the administration

Errors in frequency management have as an immediate consequence an inefficient use of the scarce resource spectrum – independently whether the spectrum is centrally managed by the State or whether refarming can be handled by private entities. In turn this inefficiency may lead to high costs for society and/or an uncompetitive economy and could adversely affect the granting of future applications.

This decision-taking process will cover a number of aspects relating to the comparison of the future use of spectrum and the incumbent use(s) of spectrum in the first instance on a technical level (in order to consider whether sharing is possible or not) and in the second instance on a more abstract level – with exception of the frequency efficiency parameter (in order to answer the question whether the incumbent use(s) should be removed out of the band or not). This implies that the information at disposal of the administration must be of very high quality with regard to both content and reliability.

Following the principle according to which voluntary measures are preferable to constraining measures by the Frequency Management Authorities, before coming to the conclusion that a refarming process necessitates the incumbent spectrum use(s) to be removed, the NRA should consider all other possibilities. In particular, it should both check that sharing is possible in the first-choice candidate band and that no alternative spectrum bands would allow sharing.

One decision-taking tool which may be helpful for spectrum management authorities when attempting to answer this crucial question whether to refarm or not is scenario-planning. The purpose of scenario planning for spectrum management authorities is not to wait until events having an influence on spectrum management happen and then eventually react to these events. Scenario planning is about anticipating the events in order for the reaction to be less costly (in time and/or money) as the events and the reaction necessary to cope with them have already been considered. Scenarios may help in finding the events/milestones which could give the signal to the spectrum management authority in an early stage that an incumbent spectrum application is very likely to become an inefficient use of spectrum – whether solely from the technical point of view or simultaneously from the political, socio-economical, technical, etc. points of view. Accordingly refarming measures could be started much earlier or unnecessary measures could be avoided. Scenario planning thus can provide for flexibility, effectiveness and speed when managing the spectrum at a strategic level. **Annex III** gives more details on the subject of scenario planning.

5.3 Refarming tools

Chapter 5.3 describes various tools suitable to carry out refarming of frequency bands. These tools are grouped into three general classes: financial, administrative and technical tools.

Occasionally, some of the tools might be included under more than one of these areas. In such cases a tool was placed in the area of its dominant aspect. It was chosen not to have a separate class for 'economic' tools because virtually every tool, upon closer inspection, is found to have a direct or indirect economic component. The resulting matrix of refarming tools is not designed to be an exhaustive list, but to show the basic tools for performing refarming studies.

The tools are also characterised as being relevant for achieving intended results in short, medium or long term. This classification is mostly intended to show relative efficiency and expediency of the tools, while the actual duration of the processes (in years) is difficult to estimate as it is likely to vary depending on particular refarming case, country, etc. However it was assumed that short term could be in the order of one to three years, medium - three to five to ten years, and long term around ten years and beyond.

5.3.1 Financial measures (F)

It is essential that in case the spectrum management authority wishes to use these instruments it has to ensure two points. Firstly, that there is an adequate legal basis. Though in particular compensation could be based on general principles of administrative law, it is better to base these payments on exhaustive legal provisions. This can avoid legal challenges in particular challenges, concerning the system for establishing the height of the compensation. Secondly, as it the case for any other payment of money to players on a market, the compliance of these financial instruments with international rules on Subventions (WTO) and State Aids (EU) should be checked.

F1 – Compensation to incumbent spectrum user
The compensation of licensees or the compensation of the clients of the licensees, for short term refarming processes.

If the refarming has to be completed in a short time frame, consideration may be given to the use of financial compensation to the existing users. This raises the issue of who will ultimately pay for this compensation. There are a number of options:

- The new entrant pays for the migration

A compensation arrangement is made between the incumbent user and the new entrant, usually with the assistance of the administration.

- The administration pays for refarming

Compensation for refarming to be paid directly from federal tax receipts or from the income derived from licence fees.

- A national refarming fund is established .

The national spectrum management authority administers a fund created either from the payments of new operators, from licence fees or from the state budget. This fund could be then used for paying compensations for network redeployment, financial incentives to accelerate refarming process, etc.

Such a fund could be contributed to with revenues from radio license fees in various ways: by new entrants, by all licence holders, by spectrum pricing/auction revenues, or combinations of the aforementioned. If the fund is supplied by several categories or all radio spectrum users such a fund makes it possible to spread the costs over a large group of contributors. The establishment of such a fund generally requires a change in the law and the political will to do so, which might be time consuming.

F2 – Spectrum pricing
Spectrum pricing may be used for refarming by creating cost incentives for spectrum users to relocate between particular bands. This is done by differentiating spectrum use fees depending on the band and technology used, e.g. the spectrum fees for using an old (spectrally inefficient) radio technology or use of congested bands may be set at a higher levels. A positive incentive would be if the use of modern (spectrally efficient) technologies or use of less congested frequency bands would incur lower spectrum use fees.

The ultimate goal being that in the set timeframe the licensee voluntarily withdraws from the spectrum by handing back his radio license ("voluntary refarming") by making another bands more financially attractive.

F3 – Licence fee waiver
Licence fees (frequency assignment fees/contributions) may be waived wholly or partly (for a specified or unlimited period) if the licence holder is willing to clear the band before the due time, or to replace the currently used technology with more spectrally efficient technology, etc.

F4 – Tax bonus
If a refarming process can be proven to place particularly heavy financial burdens on an incumbent user, compensation could be paid in the form of a tax bonus. What types of tax could be eligible would have to be studied on a case-by-case basis. Compatibility of such tax bonuses with national or international law (e.g. EU law on State Aid and WTO rules) would need to be considered. This could be a source of legal complications, which should therefore be carefully investigated.

F5 – Compensation to end-users
Providing some kind of incentives for operating companies may not be the only option for supporting technology changes, particularly when they affect large parts of the population (e.g. television and radio broadcasting). This may be complemented by some incentives at the end user level. Options considered may e.g. foresee subsidising terminal equipment for the forthcoming digitalisation of TV and radio broadcasting.

F6 – Radio Equipment Take-Back Incentive
A refarming process could fail simply because consumers' terminal equipment cannot be properly withdrawn within the desired timeframe, thus preventing introduction of the new service. In this case, payment for taking back consumers' radio equipment could accelerate or even enable the planned redeployment. Or it could be the exchanging of old equipment for new ones for a low price.

5.3.2 Administrative measures (A)

A1 – Licence revocation
Licence revocation is an administrative act of withdrawing rights of frequency use from a licensed user. However it should be noted that such action in principle violates a general principles of administrative law, forbidding withdrawal of privileges given to legal or private person by a prior administrative act without good reasons or without compensation. This is therefore only acceptable when early warning is given.

This means that licence revocation, in cases where no early warning can be given, in most cases may be used only in association with some other provisions or refarming tools. For example, licence may be revoked upon expiry of term of the licence (normally licence may be extended after the end of its validity period) or licence may be revoked before its end of expiry and some financial compensation is paid to the licensee (e.g. tools F1).

A2 – Issuing overlay licences (overlay auctions)
Overlay licences have been used in several non-European countries, including the USA, Australia and New Zealand. The issues identified for consideration in granting overlay licences are:

- the rights of incumbents to interference protection;
- the new entrants' rights to interference protection; and
- the grounds on which the new entrant may ask the incumbent to vacate the spectrum.

Overlay licences may be used to give the overall right of managing some block of spectrum, already encumbered with some prior users, usually holding site-specific (apparatus) licences or licences for operating in an area lesser than that, authorised by the overlay licence. Very often the most appropriate means for granting such overlay rights is through an auction (overlay auction).

Granting overlay rights can be useful when there is a need to clear spectrum of existing users, or when it is regarded as useful to create alternative arrangements for managing spectrum. In the first case, the owner of overlay rights would negotiate with users of spectrum to determine when and how it should be vacated. In the second case, particular bands encumbered with users would be just transferred under the spectrum management mechanism established by the owner of overlay rights.

So far this tool as such was not in use in European countries, but some similar forms of delegating spectrum management functions for a given spectrum block or particular user group were in place in some CEPT countries. The use of overlay licences in CEPT countries may become more prominent in the future.

A3 – Encouragement (authorisation) of secondary spectrum trading
The creation of a secondary market through the introduction of spectrum trading could provide a powerful mechanism to redistribute spectrum dynamically in response to changing conditions. It could also provide market information feedback to guide administrative pricing and help ensure licence fees are set at the economically optimal level.

Secondary trading is much more than the traditional central spectrum management suited to respond rapidly to changing requirements. More importantly, in this case a public administration is not seen as limiting factor, constraining developments of new services.

The application of spectrum trading is discussed in detail in **Chapter 6** below.

A4 – Changing licence conditions (removing barriers)
By using this measure, Administrations allow refarming by the users themselves, when intended change of radio use does not imply or require change of ownership for frequency use and does not pose interference problems.

Examples of such processes could be allowing existing user to introduce new technology, which was not originally foreseen by the licence (e.g. change to digital modulation within the original assignments to analogue transmissions). It is obvious that introducing these new technologies requires that the Administration has been informed about the changes and has approved them.

A5 – Licence expiry
Waiting for the expiry of the radio licences is always “first choice” activity if a new application has to be used in a frequency band. The qualification of "first choice" is due to the fact that the waiting for the expiry of the radio licenses is (1) not costing any extra money to the taxpayer and (2) not generating a breach of the confidence spectrum users put in the spectrum management authority.

Information provisioning
Administrations may provide some incentive for relocation, by e.g. illustrating high congestion of a overused band, or by showing benefits of use of higher bands (less interference, etc.).

In a more general sense, information provisioning should be indispensable part of administratively managed refarming processes in order to show transparency and make users aware at an early stage of these administrative acts.

Economic impact studies
This is an indirect complementary measure, designed to assist decision making in the area of refarming by providing comprehensive studies on the subject. The focus of such studies could be the economic implications of refarming for an incumbent user (migration costs, market forecasts for the technology in the current and alternative bands, etc.) as well as for a new user (compensatory payments, higher licence fees in wanted congested band, market studies, etc.).

5.3.3 Technical measures (T)

Technical measures are indispensable in the process of frequency management and are embedded in all activities of NRAs. They are also assisting in the carrying our of refarming processes. Monitoring activities (estimating the actual spectrum occupation, monitoring the gradual withdrawal of incumbent users, measurements in studying interference potential, etc.), technical studies (sharing studies, studies of possibilities to re-tune the old or new equipment, etc.) and other similar technical measures are likely to be used in association with most of the various tools described in whole of Chapter 5.

The following part of this sub-section lists some of the specific technical measures, which might be considered as refarming tools on their own.

T1 – Imposed sharing (time-limited, conditional)
By this measure administrations may require that the incumbent user accept some kind of sharing with a new service. Such sharing may be time-limited or involving some compensatory provisions, if there is a burden involved for incumbent user.

T2 – Extended tuning range of equipment
This development may ease significantly the later appearing need for refarming. This measure is very useful if the refarming need is identified well in advance, so that all new equipment for the incumbent networks may be required to have extended tuning ranges. Then, when the refarming is triggered, relocation of the incumbent user to an alternative frequency band may take place much more easily and with fewer resources involved.

T3 – Re-programming of software-defined radio equipment
This is a future refarming tool. See a brief discussion of the potential benefits of software defined radio in section 2.3 of the Report.

T4 – Encouraging or imposing use of frequency agile equipment
This is an indirect precautionary measure, similar to the one described as T-2 above. It may become much more important with the arrival of software-defined radio. Then the obligation or encouragement to use a software-defined radio may prepare the ground for later ultimate refarming at a short notice by means of the tool described as T-3.

5.3.4 Appropriateness of different measures to different timing of refarming

The various refarming tools, described in this section, are of a different nature and require different time scales for their implementation. Therefore the following **Table 1** is designed to illustrate the applicability of various refarming tools depending on the required time-scales of refarming.

Term \ Measures	Technical	Administrative	Financial
Long-term	T2 T4	A1 A3 A4 A5	F2
Middle-term	T1 T2	A1 A2 A3 A4, A5	F2 F3 F4 F5 F6
Short-term	T1 T3	A4 A5	F1 F3 F4 F5 F6

Table 1: Appropriateness of various refarming tools to the required time-scales of refarming

However it should be noted, that the refarming period depends on the nature of the affected service, i.e. it is closely linked to the life cycle and typical licence duration of the network which should be relocated. For example, long term for a public network as GSM may mean a time frame of around 20 years, while for PMR services long term could be in the range of 5 years.

5.3.5 Summary

Refarming Instruments \ Required Timeframe for Refarming		Short term process	Middle term process	Long term process
I.	**Licence expiry** **[A5]**	Appropriate	Appropriate	Appropriate
	Revocation, Modification of licence **(without compensation)** **[A1, A4]**	Appropriate	Appropriate	Appropriate
II.	**(Revocation, Modification and)** **Compensation Licensees** **[A1, F1]**	Appropriate	Appropriate	Appropriate
	Compensation clients licensees **[F5, F6]**	Appropriate	Appropriate	Appropriate
III.	**Spectrum pricing** **[F2]**	No	Appropriate	Appropriate
	Overlay licenses **[A2]**	No	Appropriate	Appropriate
IV.	**Spectrum trading** **[A3]**	Appropriate	Appropriate	Appropriate

Appropriateness/Highest effectiveness: Most appropriate = grey box

Table 2: The appropriateness of various refarming methods

Concerning this table some explanatory or forewarning remarks are necessary:

- General remarks:

  For the spectrum management authority the major criterion for the choice of the adequate refarming instrument is the time factor. Accordingly, the timeframe in which the refarming process must be concluded is displayed at the head of the columns. In general, the spectrum management authority will have identified the timeframe in which the refarming process will have to be finalised already when answering the question whether a refarming process should take place or not.

- With regard to the category of **refarming instruments I:**

  Waiting for the expiry of the radio licenses is always the "first choice" activity if a new application has to be used in a frequency band. Voluntary withdrawal is of course likewise a first choice measure. It is in the interest of all parties concerned (spectrum management authority, licensee, eventually the taxpayer) if the usage of the spectrum happens on such a consensual ground.

- With regard to the category of **refarming instruments II:**

  It is worth repeating that refarming tools implying any kind of compensation should in principle only be considered if the financial means for such compensation are at disposal. Ensuring this financing is not a problem if the spectrum management authority in charge of the refarming process can make the money available out of its own funds or a refarming fund. If, however, the financing of the compensation scheme of incumbent spectrum users is dependent on the general budget of the State, extensive negotiations with the Ministry of Finance are to be expected. Accordingly, though the refarming tools implying any kind of compensation are classified as tools that are appropriate for a refarming process, which shall take place in the short term, this appropriateness is dependent on the availability of the monetary funds. Insofar as the spectrum management authority is dependent on the authorisation of another body of the administration, the negotiations, which are a corollary of this division of responsibilities, should be taken into account when setting the required timeframe for the refarming process.

- With regard to the category of **refarming instruments III:**

  This category of refarming instruments is also only efficient in the short term if some preconditions are fulfilled. These preconditions are not financial preconditions but institutional and/or preconditions with regard to the process. Indeed, spectrum pricing and the employment of overlay licences need first of all a clear legal framework. For the first tool the fees have to be set in a regulatory provision, whereas for the second the obligations of the incumbent spectrum user have to be established. Moreover, the procedures for the attribution of overlay licenses need also to be available. These rules and/or procedures cannot be set up overnight. They must be carefully planned and thought through. Accordingly, if a spectrum management authority considers using spectrum pricing or overlay licenses as spectrum refarming instruments, it must have made sure well in advance of the occurrence of a refarming case where it wishes to use these tools that the legal and procedural preconditions are fulfilled.

- With regard to the category of **refarming instruments IV:**

  The fact to catalogue spectrum trading among the refarming tools in the table above may be misleading. Similarly to the considerations regarding the category of refarming instruments III, if in a country spectrum refarming can be managed by private bodies by means of spectrum trading, the spectrum management authority must have made sure well in advance of a refarming case where it wishes trading to lead to the refarming that the legal and procedural preconditions are fulfilled. But spectrum trading is not a tool a spectrum management authority will impose as the method for the refarming of a band. If spectrum trading is available and refarming is possible within the framework of trading, then the spectrum users will use trading when it suits their needs best. Trading will not be employed by the spectrum users because the spectrum management authority wishes so. What is meant when listing spectrum trading in the table above is that when the environment for trading of frequencies exists it can be expected that spectrum users will take advantage of it especially when the new spectrum user who wants to introduce a new spectrum application wishes to have access to spectrum on the short term. Clearly this will happen without the spectrum management authority taking any initiative. However, it must have ensured beforehand that the prerequisites for trading have been implemented.

5.4 Recent CEPT experience with harmonising refarming

In recognition of the clear benefits of harmonisation of any spectrum management decisions, including those regarding refarming, the CEPT has recently taken the first steps in harmonising certain refarming measures. The case concerned the use of older generation cordless phones, known as CT1, CT1+ and CT2 in certain parts of the 900 MHz band. The conclusions from public consultations in the Detailed Spectrum Investigation Phase III (see section 1.1) were that the use of these types of cordless telephony is steadily decreasing, to the benefit of more modern digital technologies such as DECT. Therefore the final DSI Phase III report recommended to ERC to agree on common time-scales for the phasing out of

CT1/1+/2 applications from the 900 MHz band. Such harmonised approach would allow implementation of new pan-European services, or give more room for expansion of existing ones, such as GSM mobile telephony.

Another type of applications foreseen to use the original CT bands were the so called Short Range Devices (SRD), a category of unobtrusive low power devices, which recently become increasingly pervasive in daily life, from remote car-alarm keys, personal aids and audio to sophisticated goods and people tracking applications. Such wide-spread universal use would undoubtedly benefit from the world-wide or at least wider regional harmonisation of allocated frequencies.

In devising an approach for the harmonised refarming measures, the ERC decided to follow in this case a two-tier procedure. First, two Decisions were developed, which established the common time-scales for the phasing-out of the CT applications. These Decisions are already adopted by the newly created ECC and became ECC/DEC/(01)01 and ECC/DEC/(01)02, dealing with CT1/CT1+ and CT2 applications respectively.

These ECC Decisions establishing general requirements and time-frames for harmonised phasing-out actions were then complemented by a separate ERC Report 111 "The regulatory procedures to be followed when changing frequency allocations". This Report describes in greater detail what steps could be appropriate for Administrations, wishing to implement decisions on phasing-out of particular types of radio systems or equipment. In particular, the Report made a distinction between the phasing-out of two cases of equipment , namely the licensed and non-licensed.

These first CEPT experiences on harmonised refarming initiatives proved to be successful, as the development and adoption of these regulatory documents were unanimously supported by many CEPT Administrations. Within the first half year after publication of the ECC/DEC/(01)01 and ECC/DEC/(01)02, they were already implemented or in the advanced stages of implementation by respectively 12 and 13 European countries.

5.5 Calculation of refarming costs

Whenever the requirement arises to compensate the incumbent user for freeing the band in case of refarming, there will be a need to calculate the refarming costs in advance of agreeing on final refarming arrangements. In most cases the compensation to the incumbent will be required when his use of spectrum is justified either from legal (e.g. non-expired licence with still sound authorised business) or purely operational point of view (e.g. military operations, which have to be transferred to another band/media). In those cases the cost of refarming will need to be calculated in order to provide sufficient basis for sustaining the legitimate operations, e.g. by relocation of operations to another band.

It could be noted, that the calculation of refarming costs does not by itself depend on the source of the required funds (see tool F1 in section 5.3), on the contrary, the amount of the involved cost is crucial for finding and committing those prospective sources to this task.

Therefore one important step in preparing for administratively managed refarming will be the determination of refarming cost. Either a joint task force established by the involved parties (primarily the Administration, incumbent and future spectrum users) could perform this task, or it could be outsourced to an independent research institution. Whatever the arrangements, this exercise may by itself require sufficient resources in terms of committed manpower or outsourcing budget. This has to be taken into account beforehand and, unless otherwise arranged, should be also added to the final cost of refarming.

The cost of refarming would naturally depend on the kind of replacement provided to legitimate incumbent use, e.g. whether it is transferred to another frequency band(-s), or to another media, e.g. cable/optical communications, outsourced telecommunications services, etc. The best approach would be to calculate several such options for the cost of refarming and then use the conclusions (the most financially attractive option) for recommending relevant replacement for the incumbent users.

The basic cost of refarming would normally include:

1. The cost of modifying the original equipment, if it could be re-tuned/modified for operation in the provided alternative bands, or
2. The cost of replacing old equipment with new , when original equipment may not be adjustable for operation in the provided alternative bands. This includes not only the cost of new equipment itself, but also compensation of remaining book value of the original equipment, of course subject to standard depreciation factors;
3. The cost of maintaining the communications services of incumbent users during the transition period (temporary back-up, e.g. by temporary outsourcing communications services, etc.);
4. The cost of all necessary works for re-tuning an old or installing new equipment;
5. The cost of necessary adjustments of the incumbent user to the changed network operations (different logistic services, spare parts, personnel training, etc.);
6. All necessary administrative overheads.

Fortunately, all of the above costs may be based on objective assumptions and factors, so the calculation of basic costs may be performed in a reasonably objective manner.

However, besides these objective costs, the overall financial impact of refarming could also include other less obvious costs. This could be the cost of insuring long-term sustainability and efficiency of incumbent operations (e.g. cost of maintaining the same defence capabilities if the range/functionality of the original radio equipment changes due to refarming).

When replacement equipment is sought, every effort should be made to use the most widely commercially available equipment, thus also implying the right choice of the replacement bands. However, if for some reasons the commercial off-the-shelf equipment can not be used (e.g. for replacing military equipment with more stringent specifications), additional modification costs should be also added.

On the other hand, the possible cost reduction factors should also be properly taken into account. Such reduction might be possible because of potential benefits of newly planned networks and procured modern equipment. For example, the number of required channels or stations may be reduced because of the increased throughput or range of new modern systems. The overall network efficiency and number of required support functions may be reduced by using the uniform solution across all of the newly established network, as opposed to "ad hoc" occasional built-up of the original network over the long period of time. Economies of scale in procuring large numbers of equipment at a time may also have a significance.

This brief review of the principles of calculating cost of refarming shows again that this exercise in itself requires sufficient time, resources and expertise and therefore should not be underestimated in preparing or just considering the refarming action.

A detailed example of calculation of cost of refarming in France is provided in **Annex 1** of the Report.

6 SUBSIDIES AND STATE AID

6.1 Introduction

When discussing the issue of financial compensation to the users in case of refarming, this leads automatically to the question, whether this compensation is a subsidy or state aid.

Subsidies or State aid, are paid by or follow the action of the State, its administration or of organisms under State control. There is a component at the national level for the regulation of subsidies or State aid. Contributions, advantages or benefits granted to national undertakings are based on a normative act or on a decision taken by the Government, eventually they follow an order given by the latter to organisms it controls. This is part of the sovereignty of a State to use the financial means at its disposal – or at the disposal of the economy – in the way it deems to be politically optimal. This regulation at the national level will not be part of the present analysis.

There is also a component at the international level for the regulation of subsidies, respectively State aid. Due to their negative effects on their budgets if they engage in a race of subsidisation of their national undertakings (upwards spiralling race of amounts paid out), the States agreed to restrain themselves with the use of aid and to restrict it to the minimum. However, the limitation of State aid is a highly political exercise. States are only unwillingly discarding subsidies for two reasons: first, they protect the national market by securing jobs in certain sectors of the economy or in certain regions, and, second, as a consequence, they have a positive impact in internal politics for the government granting such aid. The present analysis aims at giving an overview of the regulations to be considered at the international level, namely the rules developed with the framework of the WTO and the rules applicable to Member States of the European Union.

6.1.1 WTO

In case of subsidisation, the government or a government agency pays out subsidies directly or requires companies to subsidise certain customers. This is a narrow definition of subsidies as it covers only direct payment of money. It is actually the definition employed at the WTO level. In Article 1 of the Agreement on Subsidies and Countervailing Measures subsidies are defined as either (a) financial contributions or (b) any form of income or price support (in the sense of Article XVI of GATT 1994) which confers a benefit.

6.1.2 European Union (EU)

A State aid is an advantage or a benefit in any form whatsoever quantifiable economically, which is granted by a Member State or through State resources to particular undertakings. The concept of an aid from state resources is very broad and covers not only grants, loans at a low rate of interest and deferment of tax liabilities, but also schemes of aid financed by compulsory contributions by all traders including those who do not benefit and, in general, any gratuitous advantage such as a state guarantee of the firm's debt.

At the level of the EU it is not the term Subsidy that is used. The term employed in the EU is State aid. The latter's definition is much broader than the definition of Subsidy in the Agreement on Subsidies and Countervailing Measures – though it is addressing the same concept. The definition of State aid flows from Article 87 of the Treaty of the European Union (ex-Article 92). This article can be broken down into five tests to establish if a measure constitutes State aid. A State aid will only be present if all five tests are met:

- Is the measure granted by the State[10] or through State resources? Any advantage conferred on a firm – without payment or against a payment by the latter which corresponds only to a minimal extent to the figure at which the advantage can be valued – by any kind of local or state government, public or private agencies subject to State control or bodies appointed by the State – which could be a separate public body or a private company. The State has to be understood in the broadest possible sense.
- Does the measure of the State confer an advantage to the recipient, respectively beneficiary? Accordingly, it is the effect of the measure that confers to the latter the qualification of State aid and not its form[11]. The effect of a State aid is to enable undertakings to make savings as it reduces the charges the latter has to bear[12].
- Does the measure favour certain undertakings or the production of certain goods? This selective character of a State aid allows to make the difference with general Government measures which have an across the board effect on all firms and all sectors. General tax measures or other economic policies that set the climate for business in each country are not the concern of the State aid rules.
- Is the activity tradable between Member States? The same interpretation for this notion as it is the case for Articles 81 and 82 Treaty of the EU can be used.
- Does the measure distort or have the potential to distort competition? The same interpretation for this notion as it is the case for Article 81 Treaty of the EU can be used.

6.2 Why is there a need for international regulation of Subsidies or State aid?

Subsidies, respectively State aid, are liable to interfere with the normal interplay of competition and to distort trade between States, respectively Member States, whereas the WTO, respectively the EU, aim to establish a market of global, respectively regional, extent based on free competition. As the Subsidies and State aid generate a market distortion they have been regulated at the international level.

The reason why State aid are damaging is given by microeconomics. An aid from a State to an undertaking results in the subsidy of production costs and/or of positive or negative externalities[13]. Whereas competitive firms seek to keep ahead of the game by producing a mix of output consumers desire with the most efficient combination of resources, either industries at a comparative disadvantage are sustained with subsidies – i.e. their production costs are artificially reduced – as well as trade barriers or some competitors do not have to bear the negative externalities or do not obtain any reward for the positive externalities the production generates. These subsidy costs, paid by taxpayers or borne by third parties, can rival the costs paid by consumers.

Artificially reduced production costs, not borne negative externalities – which are uncompensated costs which are imposed upon individuals who are not directly involved in the production of goods –, and rewarded positive externalities – which are benefits to third parties who do not have to pay for these benefits – generally lead markets to produce a larger quantity than is desirable.

---

[10] Following the ECJ rulings in Cases C-72 and 73/91, Sloman Neptun, [1993] ECR I-887 and Case C-189/91, Kirsammer-Hack, [1993] ECR I-6185 to constitute a State aid the aid must necessarily be financed out of State resources (see also Case 82/77, Van Tiggele, [1978] ECR 25). However, many knowledgeable commentators disagree with this interpretation by the Court and still support the position the Commission had previously to these rulings of the ECJ, position according to which a State measure did not have to be financed out of public funds in order to be considered a State aid.

[11] Case 173/73, Italy v Commission, [1974] ECR 709.

[12] Case 30/59, De Gezamenlijke Steenkolenmijnen v High Authority, [1961] ECR 1; Case 47/69, France v Commission, [1970] ECR 487; Case 61/79, Denkavit Italiana, [1980] ECR 1205.

[13] The term "externalities" refers to all costs or benefits of a market activity borne by a third party (someone other than the immediate producer or consumer). Whenever external benefits are present, the market will underproduce goods. Whenever external costs are present, the market will overproduce goods.

The idea of economic efficiency is that since resources are scarce any allocation of these resources should ensure that there is no wastage. A resource allocation is said to be efficient if one could not make it any better. Accordingly, in the case where the quantity produced of one good is larger than the quantity which would be efficient the allocation of resources would be wasteful.

6.3 Which rules are dealing with Subsidies, respectively State aid?

6.3.1 WTO

The most important dispositions concerning Subsidies can be found in **Articles VI and XVI GATT** and in the **Agreement on Subsidies and countervailing measures** (part of Annex 1A (Multilateral Agreement on Trade in Goods) to the Agreement establishing the World Trade Organisation).

This agreement does two things: it disciplines the use of subsidies, and it regulates the actions countries can take to counter the effects of subsidies.

The agreement defines three categories of subsidies: prohibited[14], actionable[15] and non-actionable[16]. It applies to agricultural goods as well as industrial products, except when the subsidies conform with the Agriculture Agreement.

Articles 4, 7 and 9 of the Agreement on Subsidies contain the provisions in case of a reason for a State to reckon that another country grants unlawfully Subsidies or that these Subsidies lead to a serious prejudice of its interests. The affected State can request consultations with the other country. The aim of this consultation is that the concerned States find an agreement. There are detailed rules for deciding whether a product is being subsidised (not always an easy calculation), criteria for determining whether imports of subsidised products are hurting ("causing injury to") domestic industry, procedures for initiating and conducting investigations, and rules on the implementation and duration (normally five years) of countervailing measures. The subsidised exporter can also agree to raise its export prices as an alternative to its exports being charged countervailing duty. In case of non-agreement concerning prohibited Subsidies and Actionable Subsidies the matter can be referred to the Dispute Settlement Body (DSB). Concerning Non-Actionable Subsidies the requesting State can refer the matter to the Committee on Subsidies and Countervailing measures (see Article 24).

The reaction to subsidisation in the exporting country is often a special offsetting import tax (countervailing duty) from the importing country. Countervailing duty is charged on products from specific countries and therefore it breaks the GATT principles of binding a tariff and treating trading partners equally (MFN – Most Favoured Nation). The Anti-Dumping Agreement provides an escape clause to these principles. The Anti-Dumping Agreement concerns the actions governments may take against dumping. But the Agreement also says that before imposing a duty, the importing country must conduct a detailed investigation that shows properly that domestic industry is hurt. Countervailing duty can only be charged after the importing country has conducted a detailed investigation and made a request for a consultation.

In addition the Anti-Dumping Agreement (Article 30) foresees the possibility for Members to use the WTO's dispute settlement procedure to seek the withdrawal of the subsidy or the removal of its adverse effects.

---

[14] *Prohibited subsidies (Part II of the Agreement)*: subsidies that require recipients to meet certain export targets, or to use domestic goods instead of imported goods. They are prohibited because they are specifically designed to distort international trade, and are therefore likely to hurt other countries' trade. They can be challenged in the WTO dispute settlement procedure where they are handled under an accelerated timetable. If the dispute settlement procedure confirms that the subsidy is prohibited, it must be withdrawn immediately. Otherwise, the complaining country can take counter measures. If domestic producers are hurt by imports of subsidised products, countervailing duty can be imposed.

[15] *Actionable subsidies (Part III of the Agreement)*: in this category the complaining country has to show that the subsidy has an adverse effect on its interests. Otherwise the subsidy is permitted. The agreement defines three types of damage they can cause. One country's subsidies can hurt a domestic industry in an importing country. They can hurt rival exporters from another country when the two compete in third markets. And domestic subsidies in one country can hurt exporters trying to compete in the subsidising country's domestic market. If the Dispute Settlement Body rules that the subsidy does have an adverse effect, the subsidy must be withdrawn or its adverse effect must be removed. Again, if domestic producers are hurt by imports of subsidised products, countervailing duty can be imposed.

[16] *Non-actionable subsidies (Part IV of the Agreement)*: these can either be non-specific subsidies, or specific subsidies for industrial research and pre-competitive development activity, assistance to disadvantaged regions, or certain types of assistance for adapting existing facilities to new environmental laws or regulations. Non-actionable subsidies cannot be challenged in the WTO's dispute settlement procedure, and countervailing duty cannot be used on subsidised imports. But the subsidies have to meet strict conditions.

6.3.2 European Union (EU)

The Commission can require Member States to abolish or change aid if judged by the Commission to be incompatible with the Common Market.

6.3.2.1 Substantial law

The central material disposition is **Article 87 of the Treaty of the European Union** (ex-Article 92).

Article 87 has three parts. The underlying principle is a full-scale prohibition of State aid: paragraph (1) establishes the general principle that State aid are incompatible with the Common Market. However the ban on State aid is not absolute. Paragraphs 2 and 3 of Article 87 provide for exemptions. Paragraph 2 lists circumstances in which a category of aid is automatically to be considered compatible with the Common Market, i.e. this paragraph provides certain exceptions for situations where the aid *will be deemed* to be compatible with the Common Market. Based on paragraph 3 State aid may be declared compatible with the Common Market, i.e. it lists certain types of case where the aid *may be deemed* to be compatible with the Common Market.

Article 87 paragraph 2 states that certain types of aid are always compatible with the Common Market, so that the Commission has no discretion to decide whether or not exemption ought to be granted. Exemption is automatic, although it does not dispense the Member State from its obligation to notify its plans to the Commission. This enables the Commission to establish that the measure does indeed fall within the terms of paragraph 2.

The exemption clauses in paragraph 3 are quite different in scope. They are not automatic: they apply only when the Commission, after considering a planned aid measure, decides that in its judgement the measure ought to be exempted. Thus they give the Commission a discretion to allow aid for certain well-defined purposes.

6.3.2.2 Procedural law

The formal elements are settled in **Articles 88 and 89 of the Treaty of the EU** and in the **Council Regulation 659/99**[17]. The latter regulation codified existing law and practice, and also provided for tougher Commission powers against unlawful aid. The cornerstones of the procedure allowing the Commission to control the State aid schemes of Member States are:

a) The obligation to notify new aid measures[18].

Community supervision of State aid is based on a system of advance vetting, in which the Commission determines whether or not any aid envisaged by a Member State qualifies for exemption under Article 87(2) or (3). The Commission requires Member States to notify proposed aid or modified aid scheme in advance for clearance, with other words Member States are required to notify the Commission for approval of all plans to grant aid to or to alter existing aid arrangements[19]. This also applies for to aid that may qualify for approval under Article 87(2), if the requisite conditions are met, because the Commission has to check that that this is the case. The only exception to the notification obligation for new aid is for that classed as *de minimis* because the amount is considered to be too small to affect trade between Member States significantly and thus to fall within Article 87(1) of the Treaty.

*b) Prohibition against implementing the aid proposal during the Commission's investigation (*suspensive effect of notification – standstill obligation*)*[20].

To ensure that this vetting system is effective, the obligation to notify is backed up by a prohibition which prevents the Member State from putting the plan into effect before the Commission has authorised it, explicitly or implicitly. The last sentence of Article 88(3) provides that the Member State shall not put its proposed measures into effect until the Article 88(3) procedure has resulted in a final decision.

The Council Regulation 659/99 sets down a procedure regarding notified aid, a procedure regarding unlawful aid, and a procedure regarding existing aid schemes.

---

[17] Council Regulation (EC) No 659/1999 of 22 March 1999 laying down detailed rules for the application of Article 93 of the EC Treaty, OJ [1999] L 83, p.1.

[18] Article 2 Council Regulation 659/1999.

[19] This does not mean that an aid is illegal in case it is not notified in advance. Though a granted aid is "unlawful" when it is not notified to the Commission, or when the Commission's authorisation has not been awaited (see Article 1(f) Council Regulation 659/1999), the aid only has to be repaid when the regular procedure ultimately concludes that it is "incompatible with the Common Market". Aid may be "unlawful" or "illegal" in this sense without actually being "incompatible with the Common Market", which would mean that it did not in fact qualify for any of the possible exemption from the ban on State aid. See Case C-354/90, Fédération nationale du commerce extérieur de produits alimentaires v France [1991] ECR I-5505.

[20] Article 3 Council Regulation 659/1999.

In **Annex V** more detailed information on this topic is provided.

7 SPECTRUM TRADING

7.1 Description of spectrum trading

Spectrum trading is one of the measures that might be used in carrying out refarming of the frequency bands. For example, a network operator with a national assignment of a frequency block could sell spectrum in rural areas, where demand for its service was low and where it required less bandwidth, to another user for a different application. In such way the application in that region could change from mobile cellular to e.g. fixed wireless access.

At the same time, spectrum trading more generally facilitates more efficient use of spectrum, thus helping to achieve spectrum management tasks in a more natural (self-regulating) manner. Because spectrum trading provides incentives for incumbents to relinquish spectrum they do not require, in favour of a new entrant that can make more effective use of it and generate greater benefits. For example, when frequency bands used for television broadcasting were converted to tradable spectrum rights in New Zealand in 1995, trading made it possible to create a fourth television channel covering 70% of the population, even though there was not expected to be sufficient spectrum for a new entrant. Trading thus leads to more dynamic and productive efficiency in spectrum-use and, as part of the economy, to better economic performance in general. However it may be seen that spectrum trading may not substitute the whole structure of traditional administrative spectrum management. Trading and similar market-driven means of self-regulation may only be used as an aid to the administrative measures and require a clear set of effective but not excessively intrusive framework of regulation.

Notably, spectrum trading is not equally suitable for all types of radio service and there are many different variants of spectrum trading. This points to a flexible approach that applies spectrum trading selectively and adapts it to the characteristics of the application in question. It is also necessary for the NRA to take account of national circumstances, objectives and priorities in deciding whether and how, to introduce spectrum trading.

So, it becomes obvious that spectrum trading as any other similar means of refarming should be seen not as an individual measure but as an integral part of all spectrum management measures and mechanisms.

Spectrum trading covers a range of possibilities, from straightforward change of ownership of an assignment with no change of use to more advanced variants in which assignments may be divided or amalgamated and use changed. Not all of these are equally suitable for all services and some may be better suited to exclusive national channels than to shared local assignments.

Trading will require an effective, but not intrusive, regulatory framework to ensure compliance with international requirements, prevent interference, prevent distortions to competition and ensure access to spectrum for essential services. For example, transactions could be required to be notified to the NRA, which would have power to veto transfers.

Spectrum trading can offer significant benefits by making spectrum available more speedily for new services and applications and is a potentially useful tool for re-farming. It should be emphasised, however, that it is not a complete substitute for spectrum planning and regulation. Regulation will continue to be necessary to ensure compliance with international obligations and to avoid harmful interference. Regulation may also continue to be necessary to ensure that assigned spectrum is actually put to effective use, especially if trading were to be permitted where there is no incentive through pricing.

7.2 Advantages of spectrum trading

Potential advantages of spectrum trading may be summarised as follows:

- *Optimal use of spectrum.* Markets are an efficient mechanism for distributing a scarce resource, such as spectrum, to maximise economic welfare. A central spectrum manager cannot have as complete or as up-to-date information as the users themselves of their present and future spectrum requirements, particularly at a time of rapid and unpredictable change. Relying on regulation alone may well lead to a sub-optimal distribution of spectrum and loss of economic benefits.
- *Incentives for spectrum efficiency.* Spectrum pricing gives licensees incentives to use spectrum more efficiently as they can reduce their fees by relinquishing spectrum. Spectrum trading reinforces this by enabling them to realise the value of unused spectrum through the market.
- *Faster access for new entrants and less uncertainty.* New entrants that can utilise spectrum more advantageously than incumbents can acquire it through the market more speedily than through regulatory procedures, which necessarily

require incumbents to be given reasonable notice of licence variation or revocation and an opportunity to make representations. The resulting delays and uncertainty deter new market entrants.

- *Increased flexibility.* Markets and technology are changing fast and in unpredictable ways, especially as a result of convergence. A market in spectrum could respond dynamically to these pressures. Even if an initial allocation and assignment of spectrum is optimal, circumstances can change rapidly and trading offers scope for *dynamic* adjustment.
- *Simpler administration and less bureaucracy.* Trading offers a less burdensome and more efficient alternative to regulation. For example, it could be made simpler and easier to transfer a licence when a business, ship or aircraft changes hands.
- *Logical next step in market based frequency management.* Spectrum trading is a logical next step in allocating spectrum via the market as spectrum is nowadays more and more allocated via the market in the primary allocation process such as auctions in many cases.

7.3 Continuing need for spectrum management and regulation

Even under a system of spectrum trading, there will continue to be a need for regulation. In view of the density of radio use in parts of Europe and the close geographical proximity of neighbouring states, spectrum management cannot be left entirely to market forces.

Spectrum trading requires a clear and effective but not excessively intrusive framework of regulation to ensure the following:

- *Compliance with international regulations.* International co-ordination and harmonisation are necessary to avoid interference and bring consumers the benefits of cheaper equipment and international roaming. It would not be compatible with the international obligations on spectrum use to give licensees a completely free hand as to the use to be made of spectrum and there need to be restrictions on the types of service that may be provided in particular frequency bands.
- *Prevention of harmful radio interference,* especially where a spectrum transaction leads to a change in use of the assignment. Interference is a powerful externality that requires regulatory intervention to counteract. Radio signals can interfere with each other over considerable distances and greatly reduce or destroy the usefulness of the signals. These effects can be complex. For example, signals from two users may not interfere with each other but may combine to affect a third party. It is therefore necessary to plan spectrum use with great care.
- *Achievement of spectrum management objectives.* There will continue to be a role for strategic spectrum planning to achieve public policy objectives. More specifically some spectrum use can be safe-guarded such as spectrum reserved for scientific research (radio-astronomy).
- *Deterrence of hoarding.* Regulation will continue to be employed as a complement to spectrum trading to deter hoarding, for example through the imposition of rollout obligations. Remark: When secondary trading is introduced and works well the problem of hoarding is not obvious. The frequencies will have a market price (secondary market) and not using them will incur high opportunity costs. It even can be the opposite case: secondary trading is a very effective tool against hoarding because of the high opportunity costs a licensee will face when not using the frequencies.
- *Competition and choice.* There will need to be effective controls to prevent large users from acquiring a dominant position in the market for spectrum and using this to manipulate prices or to exclude competitors. NRAs also have an interest in maintaining diversity in radio use so that customers have a choice between, for example, self-provided systems or public networks. Spectrum trading will also be subject to the general competition law but this may not be sufficient by itself.
- *Up-to-date information on frequency assignments*. It is suggested that spectrum transactions should have to be notified to the NRA so that the national frequency register could be kept up to date. This is essential both for the proper functioning of the spectrum market and for purposes of enforcement and interference investigation and also aid to transparency.
- *Access to spectrum by essential services.* It is necessary to ensure that essential services, such as the armed forces and emergency services, have access to sufficient spectrum for their operational needs.
- *Secundary trading should preferably be embedded in other market based frequency management tools.* If this is not the case the problem may arise that licensees may obtain licences for free (first come first serve for example) and than make huge profits in the secondary market. High profits can be collected for a natural resource if in the primary allocation process traditional (not market based) management tools were applied. This may not be seen as fair and endangers the instrument of secondary trading to be successful.

7.4 Spectrum trading in practice

Spectrum trading is not equally suitable for all types of radio service and there are many different variants of spectrum trading. This points to a flexible approach that applies spectrum trading selectively and adapts it to the characteristics of the application in question. It is also necessary for the NRA to take account of national circumstances, objectives and priorities in deciding whether and how, to introduce spectrum trading.

Annex VI to this report discusses a particular example of what could be considered to be a way to apply spectrum trading for the case of Broadband Wireless Access (BWA) licences.

7.4.1 Factors to take into account

In considering whether or not to permit trading of a particular licence category, factors that could be taken into account include the following:

- *Spectrum pricing*. Spectrum trading is complementary to spectrum pricing. It should be noted that it is not necessary to limit spectrum trading to licences that have been auctioned. Administrative incentive pricing too provides a sound basis for spectrum trading if licence fees are set at an appropriate level. If cost-based pricing is used, there could still be opportunity for trading, but it would be necessary to have additional regulation to ensure that there is an effective deterrent to undesirable speculation and hoarding.
- *Supply and demand*. Licences would continue to be available from the NRA direct in most cases, as well as through the market and there may be less need for spectrum trading where the NRA has no difficulty in making spectrum available to meet demand; Generally speaking any form of scarcity is a condition that makes trading work.
- *Size and extent of individual assignments.* There is more scope for creative trading where individual assignments occupy a sizeable bandwidth and extensive geographical area and spectrum is not shared. For relatively small assignments, such as individual private business radio systems or fixed links, sub-division of assignments is unlikely to be feasible or advantageous.
- *Complexity of band plan.* Trading may complicate central spectrum planning, especially where large numbers of individual assignments have to be accommodated in limited spectrum and stringent technical planning criteria are applied. In some cases, for example in fixed links or private business radio bands, changes in the boundaries of individual assignments may have wider implications for the overall band plan; and centralised spectrum planning by the NRA may achieve greater spectrum efficiency than the market.

7.4.2 Different ways of spectrum trading

Spectrum can be traded in different ways. Radio users have different needs for spectrum. Maximum benefits will result if there is a variety of possibilities to meet these different requirements. Some of the main variants are outlined below:

- *Duration of assignment.* Some users require spectrum on a short-term basis. Others need it for a longer period. To pursue an analogy with land, a hotel room may be booked for the night, a flat may be leased for a period of months or a house may be purchased as a permanent residence.
- *Aggregation and sub-division.* Some users will wish to change the geographical of frequency boundaries of the assignments by aggregating or sub-dividing them. Sub-division is likely to work best where the vendor has a national or regional assignment.
- *Change of use.* Some users will be content to use the spectrum with no change of use. Others will wish to use it for a different application. At one extreme, assignments would be defined by the level of radio frequency emissions at their geographical and frequency boundaries with no other limitation on the use that may be made of the spectrum. That is the approach adopted in New Zealand and Australia. However, this degree of flexibility may not be feasible in the different conditions that exist in Europe.

The extent to which change of use may be permitted will depend on whether the frequencies in the band in question are subject to international harmonisation and on the potential for interference with other users. Within this constraint, some flexibility will be possible, especially at higher frequencies or unoccupied spectrum, within technical parameters selected to comply with international obligations and minimise interference. As a general rule, the greater the flexibility, the more the opportunities for trading and the greater the potential benefits.

7.4.3 Market mechanisms

There needs to be a market mechanism to bring buyers and sellers together. At its simplest, this might involve the NRA in matching buyers and sellers. More complex mechanisms involving intermediaries or some sort of 'spectrum exchange' would be more effective. This would be facilitated by the development of standardised, homogeneous lots of spectrum. Also the government can facilitate the market by keeping an up to date (publicly on-line available) frequency register. It may even be possible to envisage spectrum derivatives such as options or futures, which would enable users to hedge against future needs for spectrum and moves in market prices.

Intermediaries, who acquire blocks of spectrum for resale, could add depth to, and facilitate the functioning of, the market. It would be necessary to ensure that they meet criteria of technical competence, financial stability, integrity, independence and impartiality and do not assign licences in a way that caused interference to radio users other than their own customers. It would be necessary to balance the benefits of this approach against the possible implications for overall spectrum

efficiency of fragmenting spectrum management responsibilities. In general the use of intermediaries is consistent if a NRA in the first place has adapted a regime of secondary trading or a regime of spectrum pricing.

7.4.4 Clarity and security

A market will be impeded if there is uncertainty about the extent of spectrum rights or the security of the assignee. Development of trading will be promoted if licensees have:

- clearly defined rights, including protection from interference;
- licence terms of sufficient length with reasonable prospect of renewal and security of tenure. However, this cannot be unconditional. NRAs will wish to retain a measure of control over spectrum, which is an essential national resource, and may need to intervene to comply with any new international harmonisation measures or for reasons of public policy.

7.4.5 Information and confidentiality

In order to function effectively, markets need information. Potential sellers need to gauge interest in, and advertise, their surplus assignments. Potential purchasers need to know what is available and the price that is being asked so that they can identify opportunities for innovation and growth. NRAs are well-placed to provide this information through publication of assignment details. However, some assignment information needs to remain confidential for reasons of national security, law enforcement or commercial sensitivity. A careful balance needs to be struck between these competing considerations.

The recently adopted EU Radio Spectrum Decision (676/2002/EC) stipulates in Article 5 that the EU Member States shall publish their national radio frequency allocation table and information on rights, conditions, procedures, charges and fees concerning the use of radio spectrum. It further stipulates that this information shall be kept up to date and available to the public through appropriately developed databases.

On 31 January 2002 the ERO launched a new frequency information system called EFIS, which is a tool for the comparison of national frequency tables. EFIS will contribute to the CEPT policy objectives of harmonisation and transparency as well the European Union policy objectives. With EFIS it is possible to search for and compare spectrum utilisation across Europe as well as related information such as CEPT activities, radio interface specifications according to the R&TTE Directive and other national or international regulations.

7.4.6 Speculation

Trading may lead to the entry to the market of speculators to acquire spectrum in the expectation of an increase in its value. In economic theory, speculation is not necessarily undesirable and may even be beneficial as it provides essential liquidity. It may be prudent for an operator to keep some spectrum in reserve for future contingencies and businesses may from time to time acquire licences in advance of exploiting the spectrum, for example if they are engaged in rolling out a network. However, if spectrum is kept unused, this may act as a barrier to new market entrants and incur substantial opportunity costs. However this may not be probable because speculation has a price: if these frequencies will have a value in the secondary market, speculation will face high opportunity costs.

Tools to prevent undesirable speculation include withholding consent to transfers, application of administrative incentive spectrum pricing, enforcing ‘use it or lose it’ conditions in licences or imposition of a ‘windfall tax’. This is a complex issue that requires careful analysis. However if licensees are prevented from making a profit in the secondary market, secondary trading will not work. Profit is the only incentive that makes the market (trading) going. Here again the importance of market based frequency management tools in the primary allocation process is illustrated. If they are not applied, per definition “windfall profits” are made!

7.5 Different modalities of spectrum trading

Spectrum trading could cover a range of possibilities, from straightforward change of ownership of an assignment with no change of use to more advanced variants in which assignments may be divided or amalgamated and use changed. Not all of these are equally suitable for all services and some may be better suited to exclusive national channels than to shared local assignments.

The EC Framework Directive[21] gives some conditions for the introduction of spectrum trading. These are, that the trades should be notified to the administration, are made public and do not distort competition or result in change of use of European wide harmonised spectrum.

[21] Directive 2002/21/EC on a common regulatory framework for electronic communications networks and services of 7 March 2002

7.5.1 Trade of unchangeable spectrum rights (licences)

The transfer of unchangeable spectrum rights is something that is in some European countries already a possibility under the current Radio or Telecommunications law or at least is not forbidden. In this case the licence is transferred to another licensee with unchanged conditions via the administration or after informing the administration. This could for instance be practical when a company is sold or when a company does not need the licences any longer, since the use of (all of the) radio equipment is no longer necessary for the activities of the undertaking. This kind of trading is the most straightforward and does not give rise to possibilities of distortion of harmonised spectrum, although distorting competition could take place in the not very likely event that one company sets out to buy a large number of licences.

7.5.2 Trade of spectrum rights where change of use is possible

On the other hand there is the possibility to introduce spectrum trading where the use of the spectrum can be changed. In these cases more specific conditions have to be taken into account, such as avoidance of giving interference to other spectrum users and respecting the international harmonised spectrum. Also stricter requirements might be necessary regarding information to the NRA. (See chapter 6.4.2 for a short description of the different modalities). It is clear that in this case the trading is less straightforward and more conditions have to be met. Also the different trading options should in this case be looked at per service.

7.6 How spectrum trading supports refarming

Spectrum trading is one of the tools that can be used, as an alternative or complement to regulation, to facilitate re-farming as indicated in the following examples:

- *Frequency usage change.* A block of spectrum with incumbents could be auctioned to a single new user for a different application. The incumbents could be given security of tenure for a specified period, at the end of which they would have to vacate the band. However, the new entrant could purchase assignments in order to gain earlier access.
- *Allocation change.* A network operator with a national channel could sell spectrum in rural areas, where demand for its service was low and where it required less bandwidth, to another user for a different application. For example, the application in that region could change from mobile cellular to fixed wireless access.
- *Change in band plan.* Trading provides incentives for incumbents to relinquish spectrum they do not require in favour of a new entrant that can make more effective use of it and generate greater benefits. For example, when frequency bands used for television broadcasting were converted to tradable spectrum rights in New Zealand in 1995, trading made it possible to create a fourth television channel covering 70% of the population, even though there was not expected to be sufficient spectrum for a new entrant.
- *Short-term allocation change.* A permanent user could sell rights to temporary use of some of the channels assigned for a short-term purpose, such as a sporting event. Some channels may lie fallow every night and could be used for a different purpose such as entertainment.

7.7 Spectrum trading in a converging world

In a converging world, where spectrum use is flexible regardless of the band and the application (more applications can be applied in different frequency bands) as a result of e.g. soft-ware defined radio, spectrum trading more and more is likely to be a tool of frequency management. This in contrast to the traditional situation where interference and economies of scale of producing radio-equipment lead to a specific use in a specific frequency band. In the future of convergence only the availability of spectrum itself is important and can be traded regardless of the application (service neutral). The market than will decide what kind of use or application there will be offered and therefore refarming processes indirectly evolves as a result of spectrum trading and is no longer a traditional task of the frequency manager. This also applies to the idea that frequencies in a converging world will not be scarce anymore as they are in the traditional idea of allocating a specific frequency band to a specific use and give it to a limited number of users exclusively.[22]

8 DEVELOPMENTS WITH REGARD TO REFARMING IN CEPT COUNTRIES

The content of this section is based on the results of a questionnaire, issued to the CEPT administrations at the beginning of 2002. A total of 19 countries responded to the questionnaire. A summary of these replies is provided in this chapter, while a detailed overview of responses is given in **Annex II** of the Report.

[22] See also David P. Reed 'Comments for FCC Spectrum Policy Task Force on Spectrum Policy; July 2002.

8.1 Refarming processes

Administrations indicated which refarming tools they have used for making spectrum available for some specific new radiocommunication services. The indicative summary of those responses is given below in **Table 3 and 4**.

It may be seen from the following tables that refarming had been extensively used on CEPT already for some time, and numerous refarming tools were employed. However, from some of the replies it seems that many countries still do not have a clear policy on refarming, which in itself provided evidence for the need of the ECC Report on this subject.

It appeared that up to the beginning of 2002, the voluntary withdrawal of incumbent users was the most commonly used refarming option, with the refarming processes being still sufficiently quick in this case (2-3 years on average). However some indications were received arguing that voluntary withdrawal may not be longer relevant in the future, when quick refarming times are needed in highly congested spectrum bands.

Amongst all options, the licence expiry appears to be the default one, but the refarming processes tend to take longer in this case. Licence revoking is usually seen as a complementary (follow-up) measure together with the licence expiry.

Altogether, more than 50% of respondents (13 countries) indicated that so far they had sufficient instruments and freedom to carry out refarming.

Countries **Refarming tools/ introduced services**	**A**	**B G**	**C Y**	**C Z**	**D K**	**E S T**	**F I**	**F**	**D**	**H**	**I R L**	**I**	**L V**	**N L**	**P L**	**P**	**S**	**C H**	**G B**
Licence expiry																			
PMR-446									X										
GSM-900					2		X											X	
GSM-1800							X									4		X	
UMTS							X			4						4		7	
T-DAB	7													5				5	
WLL				X			X												
Licence revoking																			
PMR-446	1																3		
GSM-900									X	X			X	3					
GSM-1800							X									4	5		
UMTS						3	X									4	3		
T-DAB	7			X													X		
WLL				X													X		
Re-tuning of equipment																			
PMR-446					1							X	X						
GSM-900				X					X	X									
GSM-1800									X										
UMTS					1				X	4		1							
T-DAB																2			

				X				**X**										
WLL																		
Voluntary withdrawal																		
PMR-446		**X**		**X**	**1**		**1**				**3**		**X**	**1**	**X**			
GSM-900					**2**		**X**		**X**		**X**				**X**	**X**		**5**
GSM-1800					**1**		**X**		**X**		**4**			**6**	**X**	**4**		**5**
UMTS					**1**		**X**		**X**		**3**			**7**	**X**	**4**	**3**		**X**
T-DAB					**1**		**X**		**X**	**X**	**4**	**X**		**5**	**X**	**2**		
WLL	**X**						**X**				**3**			**3**	**X**			**1**
Spectrum pricing	**No use indicated**																	
Compensation from fund																		
PMR-446								**1**										
GSM-900										**X**								
GSM-1800								**X**		**1**								
UMTS								**7**										
T-DAB																		
WLL																		
Compens. by newcomer																		
PMR-446																		
GSM-900		**X**																
GSM-1800		**X**					**X**	**4**				**2**						
UMTS																		
T-DAB																		
WLL								**1**										**X**

Table 3: Overview of various refarming instruments in CEPT countries

Notes to the table:
- numbers given do indicate estimated (or past) duration of a particular refarming process;
- "X" – process duration either not specified or up to 10 years and more; "1" – one year or less;
- Other refarming tools used:
  - advance publication of change of frequency use in the national frequency allocation table;
  - shared use of frequencies, use of interleaved channels;
  - long-term agreements for gradual relocation of frequencies, temporary or conditional sharing;
  - granting "non-protected" status to unlicensed equipment.

Table 4 shows the same information in another format:

Refarming Measures in CEPT countries	**PMR 446**	**GSM 900**	**GSM 1800**	**UMTS**	**T DAB**	**WLL**
Licence expiry	D	DK 2 FI CH	FI P 4 CH	FI H 4 P 4 CH 7	A 7 NL 5	CZ FI
Licence revoking	A 1 S 3	D H LV	FI P 4 S 5	EST 3 FI P 4	A 7 CZ S	CZ S

		NL 4		S 3		
Re-tuning of equipment	DK 1 I LV	CZ D H	D	DK 1 D H 4 I 1	CZ D P 2	
Voluntary withdraw of the incumbent users	BG CZ DK 1 FI 1 IRL 3 LV NL 1 PL	DK 2 FI D IRL PL P GB 5	DK 1 FI D IRL 4 NL 6 PL P 4 GB 5	DK 1 FI D IRL 3 NL 7 PL P 4 S 3 GB	DK 1 FI D H IRL 4 I NL 5 PL P 2	A FI IRL 3 NL 3 PL GB 1
Spectrum pricing						
Compensation by a refarming fund	F 1	H	F H 1	F 7		
Compensation by the new user		BG	BG FI F 4 I 2			F 1 GB
Other instruments						

Table 4: Overview of various refarming instruments in CEPT countries (cells show country codes, see Annex II, and number of instruments)

8.2 Legal basis for refarming

In reply to this question, 10 out of 19 replying administrations indicated that they have laws or other legal rules to govern the refarming process.

8 administrations (among them 6 not having formal legal basis for refarming) indicated that they are currently developing or plan to develop new or revised refarming legislation. For detailed explanations please refer to the replies in **Annex II**.

8.3 Financial issues.

8.3.1 Compensation for revoked licence

In reply to the question of whether a revoked licence would entitle a licensee to receive a financial compensation, the answers of the administrations were divided equally between yes and no.

For countries replying that compensation would be required, it seems that this position stems from the basic principles of general administrative law, foreseeing compensation to a person (legal or physical) who lost some privileges set by the prior administrative act.

For those countries replying that no compensation would be given for a revoked licence, it remained unclear whether these countries would consider revoking the licence if some significant losses would be foreseen for the incumbent licensee. A number of examples of revoking licences, given in reply to the question, showed that this action either happened after the end of profit-generating period of the incumbent system (e.g. previous generations of mobile networks) or involved some kind of direct/indirect compensation (e.g. by administration providing alternative frequency bands).

When financial compensation is to be paid, 4 countries indicated that it would be the new user (if clearly identified) who would be responsible for contributing to the funds, while 4 countries indicated that it would be the administrations' money (state budget).

8.3.2 Refarming fund

Only three countries indicated availability of a specific refarming fund, while three others indicated that necessary financial compensation could be drawn either from the NRA budget (licence fees paid by all users of radio spectrum) or from the state budget.

8.3.3 Secondary spectrum trading

Only five countries indicated some plans to introduce secondary trading or at least stated their consideration of this issue. Three other countries indicated that certain kinds of licence transfer is already legally possible today, although this may not be seen as pure spectrum trading via the market.

9 EXPERIENCES WITH REFARMING AND SPECTRUM TRADING IN NON-CEPT COUNTRIES

9.1 Spectrum refarming

In a few countries round the world specific refarming policies have been introduced. A few examples are mentioned here.

US

In the US the radio spectrum is managed jointly by the NTIA and FCC. NTIA holds ultimate responsibility for overall long term planning and management of national spectrum resource and in particular for managing needs of federal users. In the area of commercial use of radio spectrum, authority and responsibility for spectrum management is delegated to the FCC. Because of this joint responsibility, decisions regarding the future planning of spectrum use and any associated necessary procedures, such as spectrum refarming, are being decided through a series of internal governmental and public consultations. Often such decisions and consultative processes focus on achieving a particular one-time solution tailored for particular band or telecommunication system (-s) in question, enacted through the parliamentary procedures. One example of such acts could be the Omnibus Budget Reconciliation Act of 1993, requiring transfer of more than 200 MHz of spectrum from federal to commercial use and authorising FCC to use auctions for spectrum licensing.

The subsequent FCC Statement Policy "Principles for reallocation of spectrum to encourage the development of telecommunications technologies for the new millennium (November 18, 1999)" confirmed its dedication to use the auctioning procedures for licensing of spectrum, relocated from federal use and named particular civil services foreseen in that relocated spectrum.

Later initiatives by the US Congress thought further encouragement of transfer of federal spectrum to commercial sector by authorising federal agencies to accept reimbursement payments from commercial companies, when relocating from the spectrum licensed to them. In an attempt to establish clear guidelines for carrying such principles into practice NTIA at the beginning of 2001 proposed a rulemaking on the "Mandatory reimbursement rules for frequency band or geographic relocation of Federal spectrum-dependant systems". The proposed rules provided a mechanism for the Federal agencies to submit the estimates of the relocation costs from the certain frequency bands and established procedures for further reimbursement of those costs from the proceeds of the spectrum auction. However, by the September 2001, this proposed rulemaking did not yet result in definitive conclusive legislative actions.

Canada

The Department of Industry is the authority, responsible for managing radio spectrum in Canada. During the past decade it took several policy decisions, involving one or another spectrum refarming (in Canada termed redeployment) initiative. These refarming initiatives were usually developed on a case-by-case basis as a part of the policy packages, describing licensing of one or another particular telecommunications service. However it seems that the major thinking behind establishment of redeployment policies in Canada is to ensure gradual take up of spectrum from incumbent, based on actual deployment of newly licensed system. The incumbent is then notified of necessity to free the spectrum in particular area some time (one-two years) in advance of intended deployment of new system. In that way, it is felt that redeployment would cause less problem to incumbent, would not incur major relocation costs and would potentially result in natural geographical sharing of new and incumbent systems, based on actual market demand and relative value of incumbent vs. new services in particular geographical regions.

One notable example of Canadian spectrum refarming solutions is the Industry Canada's "Redeployment plan for Spectrum Efficient Land Mobile Equipment in the Frequency range 100-500 MHz (October 1998)"". This policy decision is aimed at solving spectrum congestion for land mobile services between 100-500 MHz through achieving redeployment of old

equipment to the more spectrally efficient technologies. The plan foresees two-phased freeing of the bands from old equipment by means of applying different policy, equipment certification and authorisation tools. As such the plan provides incentives for voluntary early deployment of more spectrally efficient technologies.

In the first phase (extending to 2002/2004) the plan foresees adoption of new channelling plan, reducing authorised channel bandwidth from 25/30 kHz to 12.5/15 kHz per voice channel. In the second phase (from 2010) the channelling is to be further reduced to equivalent of 6.25/7.5 kHz per voice channel. These basic principles are supported by complementary equipment certification and licensing measures designed to ensure gradual and flexible transfer to new technologies. The problem of redeployment financing is avoided through application of long transition periods, allowing natural replacement of equipment at the end of its life cycle.

9.2 Spectrum trading

Spectrum trading experience from several non-CEPT countries may be useful in assessing the theory and practices of such processes. Therefore **Annex IV** provides detailed analysis of spectrum trading processes that so far took place in the following countries – Australia, New Zealand, Guatemala, the USA and Canada.

It may be seen from that analysis that each of the countries, which have introduced trading has done so in a different way. For instance, Australia have developed the Standard Trading Units, New Zealand has introduced management rights, which are like mini spectrum band managers, while the US consider spectrum leasing as the way forward.

The main lessons that can be learnt from experience overseas are listed below:

- There is a clear evidence that trading successfully releases spectrum for new services;
- Unnecessary restrictions on spectrum use can create barriers to entry;
- Defining detailed property rights in terms of partitioning and aggregation can be costly and unnecessary. However flexibility for partitioning and aggregation should be provided if required;
- Public registers can facilitate the market by bringing buyers and sellers together;
- Information intermediaries can provide a useful role in providing market participants with useful information;
- Auctions can be a good way to introduce spectrum trading;
- The government may be in a better position to deal with interference problems than contractors;
- There can be a useful role for spectrum band managers, to assign licences;
- Allowing change of radio use can encourage companies to be innovative;
- Spectrum Leasing can be an additional and flexible mode of trade, which releases spare capacity to those who require spectrum.

For more detailed description of different national spectrum trading regimes, please refer to information given in **Annex IV.**

10 CONCLUSIONS AND PROPOSALS

Summary of the Report

- This Report has aimed at providing deeper insight into the theory and practices of spectrum refarming. As such it could be used as a guide by Administrations on spectrum refarming and spectrum trading bearing in mind that the implementation of refarming and spectrum trading processes remains a strictly national issue.
- The Report has described the technical developments of the use of radio and has indicated how radiocommunications technology and use have changed during the recent decades. Furthermore the current regulatory regime including the EU package of Directives has been described.
- The main theme has been the introduction of refarming and secondary trading as a part of the overall spectrum management activities.
- In addition to the theoretical aspects of refarming the practical instruments of refarming and spectrum trading have been investigated and the current experiences and state of the art within CEPT countries and in non-CEPT countries provides an indication in which direction this issue will develop.
- It is expected that refarming of frequency bands involving some sort of forced withdrawal of frequency assignments might be a process that some countries may have to employ in the future, when frequencies have to be made available for the introduction of new radiocommunication services.
- Below is an overview of the conclusions on spectrum refarming, spectrum trading and on the current experience of CEPT countries:

Conclusions on refarming, advantages of refarming

- The purpose of spectrum management is to give access to spectrum for the largest possible group of interested parties in due time, while ensuring the overall efficiency of spectrum use and avoiding harmful interference between the users. Refarming in the traditional sense means the recovery of spectrum from its existing users for the purpose of re-assignment, either for new uses, or for the introduction of new spectrally efficient technologies. As such refarming is a spectrum management tool that can be used to satisfy new market demands and increase spectrum efficiency.
- When new radiocommunication services are introduced or new spectrally efficient technologies replace older technologies this often occurs as a natural migration that does not cause noticeable problems to spectrum management authorities and hence does not require the use of specific refarming instruments. It could be expected that voluntary withdrawal in some countries will happen less often in the future because of different reasons, such as high sums that have been paid for the access to the frequencies, more and quicker frequency harmonisation processes that could be expected triggered by the new EU Frequency Decision.
- However, when refarming involves a forced withdrawal of existing frequency assignments and licensees, that is not in the interest of the incumbent user, then refarming may require application of a set of various refarming instruments, such as refarming funds, pricing incentives and secondary trading.
- Hence, refarming can be a process that requires the use of many different refarming instruments by the spectrum management authorities and there is, in the case of harmonised frequency bands, merit in harmonising refarming processes insofar as the decision to refarm and the timing of the process is concerned.
- When compensation of incumbent users is considered, the issues of subsidies and state aid have to be taken into account.

Conclusions on spectrum trading

- Spectrum trading is one of the frequency management tools, which might offer advantages of dynamic optimisation of spectrum distribution, including in the context of refarming.
- Spectrum trading is complementary to market-based spectrum pricing in the form of auctions or administrative incentive pricing and also to spectrum planning and regulation.
- There are several different variants of spectrum trading, which need to be carefully planned and selectively applied within a framework of regulation that is effective without being too cumbersome and in the light of national circumstances and objectives.
- Development of trading will be promoted by certainty about licensees' rights, including freedom from interference, security of tenure and expectation of renewal, and flexibility to change the use made of spectrum within the constraints of spectrum planning and international harmonisation.

Conclusions on current experience of CEPT countries

A few general conclusions may be drawn from analysis of the replies:

- Refarming had been extensively used in CEPT already for some time, and various refarming tools are being employed both within a particular country as well as across Europe as a whole;
- From some of the replies it seems that many countries still do not have a clear methodical distinction between the various refarming tools, which in itself provides additional evidence for the need of the ECC Report on this subject.
- It seems that up to now the voluntary withdrawal of incumbent users was the most commonly used refarming option, with the refarming processes being still sufficiently quick in this case (2-3 years on average);
- The dominant use of voluntary withdrawal may explain the fact that most of the replying administrations considered their current legal regimes as being appropriate for handling the refarming cases;
- However some further indications were received arguing that voluntary withdrawal may no longer be suitable in the future, when quick refarming times are needed in highly congested spectrum portions. Then the question of appropriate legislation to handle more sophisticated refarming tools would naturally arise;
- Licence expiry appears to be a default option, but the refarming processes tend to take longer. Licence revoking is usually seen as a complementary (follow-up) measure together with the licence expiry;
- Compensatory mechanisms so far have not been widely used in Europe and spectrum trading was not allowed at all in most administrations, so further guidance from ECC on introduction of such financial (market-based) tools should be instrumental in promoting these novel mechanisms throughout CEPT.

Proposals

Summarising the content and spirit of this Report, as well as the various conclusions made above, the following proposals could be suggested for future actions by CEPT:

- While refarming and spectrum trading are and will remain a strictly national issue, the widest possible harmonisation of refarming measures and in particular time scales for such actions should be considered wherever possible. This is particularly applicable to the cases, where the system to be introduced is intended for trans-national use and when the refarming or trading measures may have an impact on operation of radiocommunication services in neighboring countries;
- The introduction of spectrum trading has taken place in Europe only in a very limited number of countries and on a very limited scale (only trading that comprises change of ownership of a licence), but might be considered to be introduced more widely and with different modes, as it potentially would offer many benefits if, at least initially, applied in a selected frequency band(-s) and with carefully designed trading rules and environment.
- Whenever any one of CEPT administrations decides to implement certain novel or larger scale refarming or trading actions, it would be advisable to notify such intended actions through the normal CEPT channels. This would ensure that the possible international impact of such actions is carefully assessed and the experiences/know-how involved with such actions promoted through the rest of CEPT membership;
- Since it is expected that many administrations may start considering the introduction of secondary trading it might be advisable to continue study of this, via tasking a project team with the topic.
- Given the future expected developments in the area of refarming and spectrum trading, it could be suggested that this Report should be reviewed regularly, with the aim of reflecting those future developments and experiences gained.

ANNEX I : REFARMING POLICY EXAMPLES FROM CEPT COUNTRIES

1. Refarming process in France

This section is based on the French experience. However, the general principles identified may well apply to other countries.

Since the radio spectrum is a public resource, it must be managed in such a way as to maximise the welfare (community surplus) stemming from the activities realised with the use of this resource.

At a time of rapid technological evolution and globalisation, spectrum management must be carried out in a dynamic fashion in order to take into account, on the one hand, the growing demand for frequencies for commercial purposes and, on the other, the spectrum resources needed to ensure the carrying out of activities of general interest, notably those that help to ensure the safety of people and goods.

In France, the spectrum refarming procedure involves evaluating the cost of the refarming operations and the management of a fund needed to finance these operations. The approach is pro-active since it requires the participation of all parties concerned for modifying the assignment of frequencies or the allocation of services.

State plays the role of intermediary by financing out of its own budget the refarming work and may require subsequent reimbursement of the sums advanced from the new users once they have obtained their frequencies. The intermediary role played by the State makes it possible to anticipate the move.

Refarming enables the spectrum manager to meet demands in the radio sector and to observe the timetable laid down for the availability of frequencies to newcomers. Its costs are broadly offset by the increase in the community surplus.

Thus, refarming emerges as a dynamic method of spectrum management that aims to maximise the welfare

1.1 – Interests driving the decision to refarm spectrum

The community as a whole must derive sufficient benefit from a refarming of radio frequency bands to merit the granting of authorisation. This benefit is reflected, in economic terms, through a maximisation of the community surplus. In other words, one must reach an equilibrium point such that no other use of the spectrum can improve the community surplus (Pareto optimality criterion).

In seeking this equilibrium point it is useful to compare the preferences (utilities) of the various players involved. Their utility functions are expressed in terms of private value and social value for the community. Private value corresponds to the profits they can derive from the use of the frequency bands, whereas the social value corresponds to the importance of the service to society at large. The calculation of private value is fairly simple, whereas quantifying the social value is relatively complex. It is possible to call on the notion of "opportunity" in trying to evaluate the social value of the service, in other words by calculating what the absence of the service would cost the community.

As regards the process of spectrum refarming, it is necessary to compare the utilities in terms of private value and social value of the agent being asked to relinquish the frequency bands and of the incoming agent.

Let $U_{outgoer}$ and $U_{incomer}$ denote the respective utilities (comprising the private and social values) of the operator leaving the spectrum and the operator who replaces him. Let $C_{removal}$ denote the spectrum refarming cost for the outgoer

If $U_{incomer} > U_{outgoer} + C_{removal}$ >> the removal is socially and economically optimal

If $U_{incomer} < U_{outgoer}$ >> the removal is not socially and economically optimal

If $U_{outgoer} < U_{incomer} < U_{outgoer} + C_{removal}$ >> a choice has to be made.

1.2 – The cost of refarming

It is assumed that, as the result of spectrum refarming, the user of a frequency band is obliged to relinquish the band and to pursue his activity in a different frequency band or to use a non-radio solution where this is possible for him.

For this user, the obligation to leave the frequency band may induce an additional cost that he would not have incurred in the absence of this obligation.

In what follows, this additional cost will be known as the "refarming cost". The removal cost $C_{removal}$ discussed earlier forms part of the refarming cost.

In the telecommunications sector in particular, the resale value of the equipment involved in the move is in most cases not known. Investments made in these networks are often so-called "sunk costs" for the users. This means that if the activity ceases the users cannot recoup their investments.

Calculation of the residual value makes it possible to determine the theoretical value of this equipment when it cannot be resold. It is useful to distinguish the residual book value and the residual economic value.

For this reason, two methods are envisaged and presented below for the calculation of the refarming cost :
* calculation using residual book value;
* calculation using residual economic value.

1.3 – Calculation of the refarming cost using the residual book value

The book value method is applied in particular when the outgoer keeps normal accounts. Moreover, in the case of commercial activity, this method takes into account the tax advantages that the outgoer has enjoyed relating to the depreciation of his equipment.

1.3.1 – Evaluation of the cost incurred by the user on leaving the frequency band

1.3.1.1 – Move to another part of the spectrum or exit from the spectrum

It must first be determined whether the outgoing user is obliged to use radio frequencies if he is to pursue his activity.

- if this is the case (as, for example, for an operator of mobile services), the outgoing user is moved to another frequency band and the cost "Cd" of this move to another part of the spectrum is evaluated.
- if this is not the case (as for example, for an organism owning fixed radio links), the two following hypotheses must be envisaged :
- the user is moved to a different frequency band and the cost Cd is evaluated;
- the user gives up the use of frequencies in favour of an alternative wire-based system and an evaluation is made of the cost Cs, corresponding to the exit from the radio spectrum.

The choice between these two hypotheses, taking only the economic criterion, leads to adopting the less costly of the two.

Let Ci be the cost incurred by the user on leaving the frequency band. Ci is equal either to Cd if the user is obliged to occupy a different frequency band, or to the smaller of Cd and Cs if the user has the possibility of adopting a wire-based solution.

1.3.1.2 – Elements to be taken into account in determining Cd and Cs

If he is to relinquish the frequency band he currently occupies, the user has to invest. The investment varies according to the project in question.

It is relatively small when a simple re-tuning of the frequencies used on the equipment enables the user to pursue his activity in the new host band with the same equipment (transmitters and receivers).

It can be much greater if there is a need to install a new network or to renew a substantial number of terminals.

The following, for indicative purposes, is a non-exhaustive list of elements to be considered in determining the costs Cd and Cs in the case of the deployment of a new network or the renewal of a set of terminals :

* for the installation of a new network:
- price of an item of equipment times number of items in the network,
- cost of installation and bringing into service,
- cost of training operators in the new system,
- maintenance costs,
- other costs : licence fees linked to frequencies, royalties, taxes, etc.

* to renew a set of terminals :
- price of a new terminal times the number of active terminals installed,
- installation and adjustment costs times the number of active terminals installed,
- customer service costs induced by the change of terminal,
- maintenance costs, etc.

In theory, Cd and Cs must be calculated on a *ceteris paribus* basis, meaning that the operating benefits the user had enjoyed before leaving the frequency band are unchanged in the new situation.

1.3.2 – The residual book value Vcr

This method makes allowance for the age of the outgoing user's equipment, taking the residual book value "Vcr " of this equipment.

The usual definition of the residual book value of an item of equipment is obtained as follows:

Vcr = purchase price of the equipment ready for use minus depreciation

Vcr represents the value of the fraction of equipment remaining to be depreciated.

If at this stage in the depreciation, its owner can no longer use the equipment, the latter, according to accounting theory, would incur a loss equal to Vcr.

1.3.2.1 – Vcr in the case of infrastructure

Often, the Vcr is given by the normal accounts maintained by the outgoing user.

Where accounting of this kind does not exist (as is the case for most parts of the public administration), the outgoing user may be given the choice of applying general accounting rules for the calculation of Vcr or bringing in an independent expert to estimate Vcr.

1.3.2.2 – Vcr of user terminals

a) The case of rented terminals

The Vcr is provided by the lessor's accounts.

b) The case of purchased terminals

For a public organism, as in 1.3.2.1

For households, the Vcr can be calculated assuming a rate of depreciation based on the observed rate of renewal for the set of terminals installed.

1.3.3 – Renewal costs

Because of technological evolution and the ageing of equipment, the occupier of a frequency band is called upon to renew his equipment even in the absence of any change of band.

Let Cr be this cost of renewal of equipment, with identical properties and the same frequency band.

Cr in this case represents the cost this occupant would incur even in the absence of any spectrum refarming.

1.3.4 – Calculation of the refarming cost

Take the user of a frequency band whose present equipment has a residual book value Vcr and who has to evacuate this band by reason of refarming.

Leaving the band means that he has to spend a sum equal to Ci (see 1.3.1) in order to be able to pursue his activities.

The fact of evacuating the band will probably mean that it is impossible for him to use his present equipment, hence causing a loss equal to Vcr (see 1.3.2).

If he were to stay in the band, he would have to spend a sum equal to Cr (see 1.3.3).

We therefore have the following relationship :

Refarming cost = additional cost for the user obliged to leave the frequency band

$= Ci + Vcr - Cr$

Remarks :

- If the calculation results in a negative refarming cost, this means that the user has an interest in leaving of his own accord the frequency band he currently occupies.

- Calculating the refarming cost of a frequency band requires, in each case, an expert appraisal to establish the actual costs of the existing network and the new network.
The results of the calculation are highly sensitive to the level of depreciation and the architecture of the existing network.

1.4 – Calculation of the refarming cost using residual economic value

The economic approach makes it possible, among other things, to leave aside the following two aspects :

- the fact that the actual service life of the equipment may be different from the life used for accounting purposes[23] (determined on the basis of depreciation periods) ;

- the possibility that the outgoing user does not apply a depreciation regime.

1.4.1 -- Analysis of the value of networks

Once the incomer has recognised his interest in using radio waves to provide his service and when it is established that the value to the incomer is greater than the value to the outgoer plus the cost of moving (in other words : $U_{incomer} > U_{outgoer} + C_{removal}$), the outgoer has five options :

a) The outgoer ceases activity : the outgoer provides a service whose value to society is small, whose technology is obsolete or which no longer has any justification ; all these are cases in which it is preferable that the outgoer cease his activity.

b) Sharing frequency bands for a single service : the existing operator uses frequencies but in an inefficient manner or is unable to justify the quantity at his disposal ; in this case, he could, without technical handicap, agree to another operator being installed to provide the same service.

c) Sharing frequency bands between different services : the incomer may exploit the host frequency band without the existing operator having to move and the latter can also continue exploiting the spectrum without interference from the incomer. This is the solution of sharing frequency bands for the provision of different uses.

[23] Depreciation for bookkeeping purposes is different from economic depreciation. Equipment that has been completely depreciated can often go on being used for several years before being replaced. In concrete terms, economic depreciation is the sum of a depreciation term (the loss of nominal value of the equipment in the course of a year) and the term representing the remuneration of fixed capital at discount rate k (or cost of capital). Only the remuneration of that portion of capital that is financed by borrowing (debt) is included in the financial charges recorded in the accounts. As a result, the depreciation for bookkeeping purposes corresponding to the cost of constant use (investment divided by the life of the equipment used in the accounts) and decreasing financial charges, presents a difference in coverage compared with economic depreciation. For the latter, the remuneration is applied to the total capital value of the investment in question, given that part of the financing is in fact obtained internally. It therefore covers both the equivalent of the financial charges and the remuneration of the investment out of own resources (remuneration of shareholders, etc.).

d) The outgoer moves his activity to another host frequency band : the incomer has the exclusive use of the whole frequency band and the existing operator must move his activity to another frequency band.

e) The outgoer moves his activity to a totally different platform : the incomer wishes to benefit from the exclusive use of the whole frequency band and the existing operator must move his activity. On examination, it turns out that the development cost of the activity of the outgoer on other frequency bands is higher than the development cost of the same activity on a wire-based support (cable, optical fibre, etc.). It is preferable, for an unchanged service, that the outgoer evacuate the frequency bands and move to an alternative platform.

Each of these cases can be tackled by an economic study of the different investment options.

Referring to the work carried out in France on the unbundling of the local loop and the calculation of network costs, the spectrum refarming cost is examined by comparing different options (again referred to in terms of "configurations").

Take the case of the operator who has to evacuate his frequency band (totally or partially) and move to a different frequency band or a different platform (or simply adjust his use of the frequency band in order to accommodate another operator). The removal of the operator (called the outgoer) must not be to his detriment. The move must involve an incentive for the outgoer. Otherwise, he will not evacuate the frequency band or will try to delay his departure. Equally, the move by the operator must not give rise to the constitution of profits. As a result, an equilibrium point has to be found through the calculation of "fair" compensation.

This is done through a comparison between the situation of the outgoer who has to bear the costs of the move and the situation of this same operator if he had not had to move and if he had only incurred the costs of renewing his equipment (baseline configuration). It is assumed that the level of service is identical in each of the cases.

In the baseline configuration, the notations are as follows :
- I_0 is the initial investment at date 0 ;
- T is the period corresponding to the economic service life (actual duration of life) of the equipment. This duration reflects the economic obsolescence of the equipment used for a given service. It is the number of years at the end of which the equipment has to be renewed. An average service life of the equipment is taken ;
- a is the rate of remuneration of capital ;
- g is the rate of technical progress in the technology employed at date 0. It takes account of the price falls that can be observed or foreseen over time for the purchase of the same asset[24]. By "the same asset" is meant an asset providing the same services (same productive capacity, same level of operating benefits and maintenance costs). This rate includes an element of technological evolution ;
- by convention, $(1 + h) = (1 + g)(1 + a)$.

For the other configurations, the following notations are added :
- t is the date of the move ($t \leq T$) ;
- Cd_t is the cost of the move at date t (this may be the cost of scrapping equipment that has become obsolete) ;
- δ_t^i is the refarming cost (see 1.2) at date t and relates to each of the "configurations" (i=1...4) ;
- I'_t is the investment in a new technology at date t ($t \leq T$). This corresponds to a substantial technological advance or to a change in the technological platform used to provide the same service as at date 0 ;
- g' is the rate of technical progress associated with the investment I'_t in the new technology used at date t ;
- T' is the new economic service life associated with the new technology ;
- by convention $(1 + h') = (1 + g')(1 + a)$.

1.4.2 – Descriptions of the configurations

The economic calculation sets out to retrace economic activity as it proceeds over time. In trying to compare investment projects which differ in terms of service life, date, etc., these investments are expressed as schedules of *ad infinitum* renewal, called configurations for present purposes.

It is assumed that the configurations compared here all provide the same services. By "same services" is meant services with the same productive capacity, the same level of operating benefits and maintenance costs. The reasoning is also on the basis of constant income, regardless of the configuration being considered.

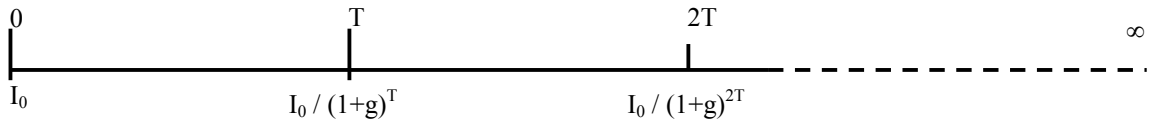
[24] For example, in the case of the unbundling of the local loop carried out in France, the equipment was split into technological groupings. In this way a "g" of 58% a year was calculated for the hardware industry, whereas the rate of technical progress was 0% a year for copper cables.

In discussing spectrum refarming, five main configurations are examined.

a) the first, F_0, known as the baseline configuration, corresponds to the case where the operator remains within the same frequency band and renews his initial investment *ad infinitum*. The renewal investments[25] are defined as a function of the initial investment (the rate of technical progress being implicitly taken into account through the fall in the cost of the equipment). The four other configurations correspond to cases where the operator moves to a different frequency band.

With the notations listed earlier, we have:

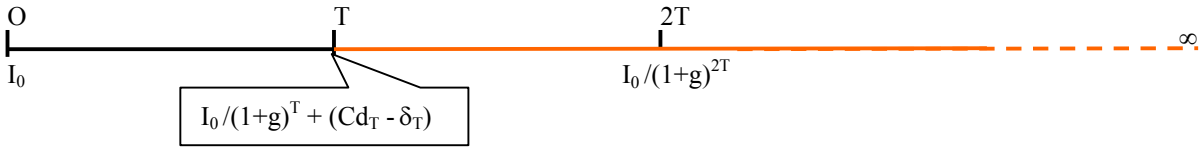
Baseline configuration F_0: the operator remains in his frequency band. He invests I_0 at date 0. At the end of period T he invests $I_0/(1+ g)^T$ and repeats this same investment schedule *ad infinitum*, as represented in the following diagram:



b) in configuration F_1 it is assumed that the operator moves at the end of period T. and renews the equipment that has become obsolete at that date. Whether in the original frequency band or the new host frequency band, the cycle for the renewal of equipment is the same, with the cost of the move being added to the cost for configuration F_1.

With the notations listed earlier, we have :

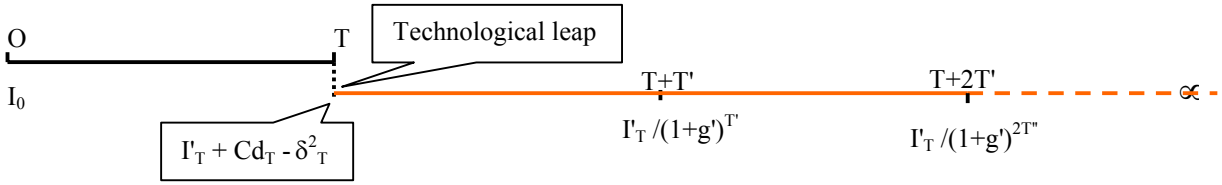
Configuration F_1 : the operator relinquishes the frequency band that he had occupied since date 0. He had invested I_0 at date 0 and moves at the end of period T. In T, he makes a fresh investment of $I_0/(1+ g)^T$ and renews this equipment *ad infinitum*.



c) configuration F_2 differs from configuration F_1 in that at the end of period T the operator invests in a new technology. It is then said that there is a technological leap from one period to the next. To give an illustration, an operator would move from his frequency band at the end of the period of use of his initial equipment (T) and would continue his activity on an alternative platform (wire-based, for example), requiring investment in a different technology.

With the notations listed earlier, we have :

Configuration F_2: the operator relinquishes the frequency band he had been occupying since date 0. He had invested I_0 at date 0 and moves at the end of period T. At date T, he changes technology and invests I'_T, characterised by a rate of technical progress g'. He renews this equipment on a like-for-like basis every period T'.

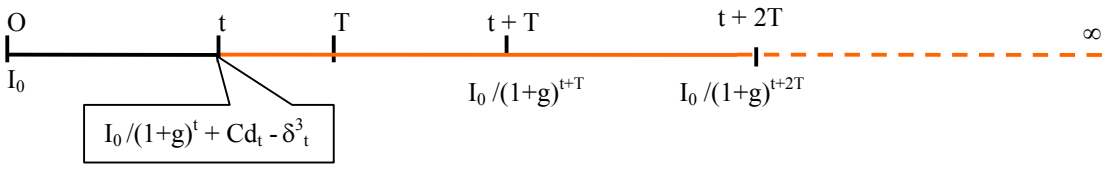


[25] This is then known as "like-for-like " renewal, meaning that the equipment has the same properties and provides the same services, but does not carry the same price, since there has been technical progress.

d) It is assumed that configuration F_3 represents the case of an anticipated move, i.e. a move that is brought forward in time. Instead of moving at the end of period T, the operator finds himself obliged (because of an administrative decision) to leave his frequency band at date t ($t \leq T$). This case arises, for example, when he is notified in the ITU Radio Regulations that the frequency band has to be liberated at a given date. The timetable for the outgoing operator and international requirements are not always compatible.

With the notations listed earlier, we have :

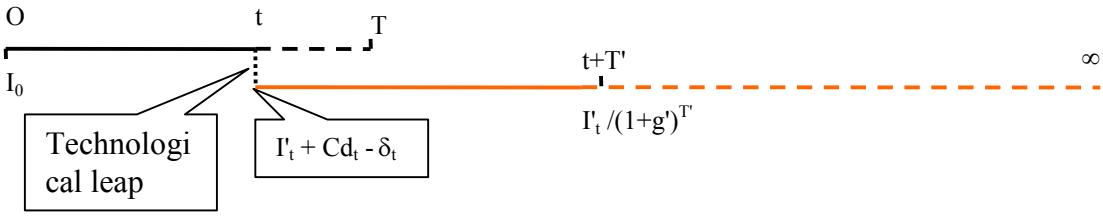
Configuration F_3 : the operator relinquishes the frequency band he had been occupying since date 0. He had invested I_0 at date 0 and the date of his move is brought forward to year t ($t \leq T$). At date t, he again invests $I_0/(1 + g)^t$ and renews this equipment on a like-for-like basis every period T.



e) Configuration F_4 is the most general case of which configurations F_1, F_2 and F_3 are special cases. It corresponds to a move brought forward to date t ($t < T$) and a new investment schedule due to the fact that there has been a technological leap between the initial equipment (used since date 0) and the equipment used starting at date t. In practice, this represents the case of an operator who leaves the original frequency band to continue his activity using a wire-based platform (cable, optic fibre, etc.).

With the notations listed earlier, we have :

General configuration F_4: the operator relinquishes the frequency band he had been occupying since date 0. He had invested I_0 at date 0 and the date of his move is brought forward to year t ($t \leq T$). At date t, he changes technology, invests I'_t, characterised by a rate of technical progress g', and renews this equipment on a like-for-like basis every period T'.



1.4.3 – Actualised costs of the configurations

The following calculations are deduced from the examination of the configurations set out above. Discounted present values of the costs at year 0 have been calculated for purposes of comparability. Taking the schedule of *ad infinitum* renewal of each of the configuration, the results take the form of the summation of the terms of a geometric series[26].

* **Baseline[27] configuration F_0 :** Let C_0 be the discounted present cost at year 0:

$$C_0 = \frac{I_0}{1 - (1+h)^{-T}}$$

On the basis of configuration 0,which represents what the operator would have done had he not been forced to move, configuration 4 can be examined, this being the most general, with the other three configurations deducible from it.

[26] The detailed calculations will be found in appendix.
[27] To each of the formulae should be added the maintenance costs which should form part of a more realistic calculation.

*** The most general configuration F_4** (technological leap, anticipated move)
Let C_4 be its discounted present cost at year 0

$$C_4 = I_0 + \frac{Cd_t - \delta_t^4}{(1+a)^t} + \frac{I'_t}{(1+a)^t} \cdot \frac{1}{1-(1+h')^{-T'}}$$

The other three configurations are merely special cases of configuration F_4 (see appendix for the discounted present costs of the other configurations F_1, F_2 and F_3).

1.4.4 – Calculation of the refarming cost δ_t^I

Configuration F_0 is the case in which the operator would have continued as before, remaining in his existing frequency band. Equity requires equalling his costs in the absence of having to move and the costs incurred by following one of the other configurations that include a move. This means compensation aimed at making the choice of configuration a matter of indifference (equal costs) and hence encouraging the liberation of the frequency bands used. This amounts to calculating the compensation that eliminates the difference between the costs for a given configuration and that of the baseline configuration ($\Delta_{i=1,\ldots,4} = 0$).

Comparison of the general configuration 4 (technological leap and move brought forward) with the baseline configuration :

$$\Delta_4 = C_4 - C_0 = \frac{Cd_t - \delta_t^4}{(1+a)^t} + \left(\frac{I'_t}{(1+a)^t} \cdot \frac{1}{1-(1+h')^{-T'}} - \frac{I_0}{(1+h)^T} \cdot \frac{1}{1-(1+h)^{-T}} \right)$$

The compensation δ_t^4 which puts the two configurations on an equal footing is found when $\Delta_4 = 0$:

$$\delta_t^4 = Cd_t + \left(\frac{I'_t}{1-(1+h')^{-T'}} - \frac{I_0 \cdot (1+a)^t}{(1+h)^T} \cdot \frac{1}{1-(1+h)^{-T}} \right)$$

At date t, the compensation δ_t^4 (valued at constant prices), is the sum that makes the choice between remaining in the initial configuration and moving activities a matter of indifference, whether this move be to a different frequency band or an alternative platform (new technology requiring investment I'_t, with a rate of technical progress g').

Comparisons for the other configurations (F_1, F_2 and F_3) with the baseline configuration will be found in an appendix.

1.5 – The refarming fund and refarming procedures

1.5.1 – The refarming fund

The fund is managed by the body responsible for managing the spectrum (AFNR : Agence Nationale des Fréquences) with a specific budget that is kept strictly separate from the AFNR's general budget.

The fund can be financed in two ways :

* Contributions from public entities for the requirements of refarming.
So far, the only contributions have come from the Ministry of Finance.
The Ministry of Finance supplies the initial share of the fund, on an annual basis of 3 million euro, increased by an additional amount determined each year on a case-by-case basis in the light of the cases dealt with. From 1997 to 2001 the contributions emanating from the Ministry of Finance have amounted to 65 million euro because of the moves required to accommodate GSM 1800, IMT 2000 and SRD applications (including Blue Tooth).

* Contributions can also come from private persons.
Users may be called on to pay their contributions into the fund at the time they obtain the new frequency band.
For example, GSM operators have contributed in 2002 for additional frequencies in the 1.8 GHz band and IMT 2000

operators have paid their contribution just after the granting of the authorisations, i.e. in September 2001.

The ministries and the independent authorities (or the entities delegated for the purpose) benefiting from the refarming fund sign a refarming convention with the AFNR.
The Board of the ANFR, on which all the ministries and authorities concerned are represented, approves these conventions.
The cumulative total of conventions signed as of 30 June 2002 is 59 million euro.
The entities that have already benefited from the refarming fund are mainly the operator France Telecom and the Defence Ministry. Other beneficiaries are notably EDF and SNCF.

1.5.2 – The refarming procedures

The procedures are launched by the part of the administration or authority responsible for assigning frequencies before the re-attribution of the frequency band. In France these bodies are known as "affectataires".

At their request, the tasks delegated by the State to the ANFR are as follows :
a) to prepare the evaluation of the various cost elements and refarming principles ;
b) to propose a schedule for the refarming operation ;
c) to organise the supervision of the procedure ;
d) to manage the refarming fund.

To carry out these tasks, the ANFR relies on a number of commissions within which consensus is sought and found. The commissions involved in the refarming operation are as follows :

* CPF : Commission pour la Planification des Fréquences (The Frequency Planning Board)
This commission receives, examines and co-ordinates the demands for frequencies emanating from the affectataires.
It has the following tasks :
- to draw up and keep up-to-date the national frequency allocation table and to harmonise, as necessary, the use of frequency bands ;
- to examine all issues relating to the use and allocation of frequencies having national or international implications ;
- to issue directives to the CAF : Commission d'Assignation des Fréquences (Frequency Assignment Commission), which is accountable to it and for which it acts as the appeals body.

* CSPR : Commission de Synthèse et Prospective des Radiocommunications (Radiocommunications Synthesis and Prospective Analysis Commission).
The CSPR contributes to prospective analyses of the radio frequency spectrum with a view to optimising its use by public and private users.
The CSPR makes proposals regarding the rules for electromagnetic compatibility, spectrum engineering and the standards needed to ensure proper use of radio systems.
The CSPR brings together representatives of the departments concerned, as well as those of operators of networks open to the public and the industries concerned.
The CSPR operates with the help of 4 sub-commissions :
– CCE : Commission de Compatibilité électromagnétique (Electromagnetic Compatibility Commission),
– CVS : Commission de Valorisation du Spectre (Spectrum Value Commission),
– CRDS : Commission des revues du Spectre (Spectrum Review Commission),
– CFRS : Commission du Fonds de Réaménagement du Spectre (Spectrum Refarming Fund Commission).

Usually, all decisions are taken by consensus. However, when this is not possible, the decision is taken by the ANFR Board, which is the highest decision-making body on matters related to the frequency spectrum. An appeals procedure can then be launched with the Prime Minister's office at the request of a member of the ANFR Board.

To date, all refarming cases have been handled using the usual procedure, with consensus obtained in the commissions concerned and with full transparency guaranteed.

Appendix

A1 – Detailed calculation of the discounted present cost at date 0 of the configurations :

$$C_0 = I_0 + \underbrace{\frac{I_0}{(1+g)^T \cdot (1+a)^T}}_{(1+h)^T} + \underbrace{\frac{I_0}{(1+g)^{2T} \cdot (1+a)^{2T}}}_{(1+h)^{2T}} + \cdots = \frac{I_0}{(1+h)^T} \cdot \left[1 + \frac{1}{(1+h)^T} + \frac{1}{(1+h)^{2T}} + \cdots \right]$$

This will be recognised as a geometric series with common ratio $1/(1+h)^T$ and first term $I_o/(1+h)^T$.

As a consequence :

$$C_0 = \frac{I_0}{1-(1+h)^{-T}}$$

The discounted present cost at date 0 of the general configuration 4 :

$$C_4 = I_0 + \frac{Cd_t}{(1+a)^t} - \frac{\delta_t^4}{(1+a)^t} + \frac{I'_t}{(1+a)^t} \cdot \left[1 + \underbrace{\frac{1}{[(1+a)(1+g')]^{T'}}}_{(1+h')^{T'}} + \underbrace{\frac{1}{[(1+a)(1+g')]^{2T'}}}_{(1+h')^{2T'}} + \cdots \right]$$

$$C_4 = I_0 + \frac{Cd_t - \delta_t^4}{(1+a)^t} + \frac{I'_t}{(1+a)^t} \cdot \frac{1}{1-(1+h')^{-T'}}$$

The discounted present cost at date 0 of configuration 1:

$$C_1 = \frac{Cd_T}{(1+a)^T} - \frac{\delta_T^1}{(1+a)^T} + \frac{I_0}{(1+h)^T} \cdot \left[1 + \underbrace{\frac{1}{[(1+a)(1+g)]^T}}_{(1+h)^T} + \underbrace{\frac{1}{[(1+a)(1+g)]^{2T}}}_{(1+h)^{2T}} + \cdots \right]$$

$$C_1 = \frac{Cd_T - \delta_T^1}{(1+a)^T} + \frac{I_0 \cdot (1+h)^{-T}}{1-(1+h)^{-T}}$$

The calculation method is similar for costs C_2 and C_3.

Configuration F_1, removal at date T followed by a prolongation of the initial situation, is one in which t=T ; T=T' ; g'=g ; $I'_t = I_0/(1+g')^t$. Its discounted present cost at year 0 C_1 is given by:

$$C_1 = \frac{Cd_T - \delta_T^1}{(1+a)^T} + \frac{I_0}{1-(1+h)^{-T}}$$

Configuration F_2, removal at the end of the period and technological leap, i.e. t = T. Its discounted present cost at year 0 C_2 is given by :

$$C_2 = I_0 + \frac{Cd_T - \delta_T^2}{(1+a)^T} + \frac{I'_t}{(1+a)^T} \cdot \frac{1}{1-(1+h')^{-T'}}$$

Configuration F_3, anticipated removal (t < T) and unchanged technology (g'=g ; T'=T ; $I'_t = I_0/(1+g)^t$.). Its discounted present cost at year 0 C_3 is given by :

$$C_3 = I_0 + \frac{Cd_t - \delta_t^3}{(1+a)^t} + \frac{I_0}{(1+h)^t} \cdot \frac{1}{1-(1+h)^{-T}}$$

By introducing (T-t), the period by which removal is advanced, C_3 can also be written :

$$C_3 = I_0 + \frac{Cd_t - \delta_t^3}{(1+a)^t} + \frac{I_0 \cdot (1+h)^{T-t}}{(1+h)^T - 1}$$

It will be seen that the closer the removal date t is to the end-period date T, the greater the diminution in the cost of the configuration and the closer it comes to the cost of configuration 1.

A2 – Comparison of the configurations with baseline configuration F_0

* Comparison of configuration 1 (removal at end of period T and prolongation of the initial situation) with the baseline configuration :

$$\Delta_1 = C_1 - C_0 = \frac{Cd_T - \delta_T^1}{(1+a)^T}$$

Equating Δ_0 to zero gives the amount of compensation δ_t^1 that equalises the costs of the two configurations :

$$\delta_T^1 = Cd_T$$

At date T, the compensation δ_t^1 is equal to the cost of removal (itself calculated at its value at date T). This is relevant, given that the baseline configuration is being compared with a configuration involving removal without technological change and without any anticipation of date. The only additional cost incurred by the outgoer is his removal cost.

$$\Delta_2 = C_2 - C_0 = \frac{Cd_T - \delta_T^2}{(1+a)^T} + I'_T \cdot \frac{(1+a)^{-T}}{1-(1+h')^{-T'}} - I_0 \cdot \frac{(1+h)^{-T}}{1-(1+h)^{-T}}$$

Comparison of configuration 2 (removal at end-period T and technological leap) with the baseline configuration :

Equating Δ_2 to 0 gives the cost of compensation δ_t^2 that equalises the two configurations:

$$\delta_T^2 = Cd_T + \left(\frac{I'_T}{1-(1+h')^{-T'}} - \frac{I_0}{(1+g)^T} \cdot \frac{1}{1-(1+h)^{-T}} \right)$$

At date T, the compensation δ_t^2 is the sum that makes it a matter of indifference to the operator whether he remains in the initial configuration or moves his activities, either to another host frequency band or to an alternative platform (new technology requiring investment I'_T with a rate of technical progress g'). The only difference between this case and case 4 is the date at which the investment in the new technology is carried out.

Comparison of configuration 3 (anticipated removal without technological change) with the baseline configuration:

$$\Delta_3 = C_3 - C_0 = \frac{Cd_t - \delta_t^3}{(1+a)^t} + \frac{I_0}{1-(1+h)^{-T}} \cdot \left(\frac{1}{(1+h)^t} - \frac{1}{(1+h)^T} \right)$$

Equating Δ_3 to zero gives the compensation δ_t^3 that equalises the two configurations:

$$\delta_t^3 = Cd_t + \frac{I_0 \cdot (1+a)^t}{1-(1+h)^{-T}} \cdot \left(\frac{1}{(1+h)^t} - \frac{1}{(1+h)^T} \right)$$

A3 – Rate of remuneration of capital

The rate of remuneration of capital varies according to the user, his activities, the calculation method used and the period of application.

In general, this rate is obtained taking a weighted average of the cost of the firm's equity capital and the cost of its borrowing. The weighting is based on the firm's debt structure.

In order to determine the cost of the firm's equity capital, account has to be taken of, inter alia:
- the guaranteed rate on the financial market (for example, the rate on 10-year government bonds);
- the observed long-period market premium applicable to quoted stocks;
- the risk attached to investments in the activity concerned;
- the firm's dividend distribution rate;
- the rate at which the firm is taxed;
- the taxation applied to distributed dividends.

To determine the cost of the borrowed portion, the rate taken is the guaranteed rate mentioned earlier increased by a premium corresponding to the firm's borrower risk.

2. Refarming process in Switzerland

Up today solely use of "traditional" instruments for spectrum refarming.
The present refarming instruments at the disposal in Switzerland are the "traditional" ones in the field of spectrum management for modifying the allocation of a frequency band. In a frequency band whose allocation will be modified in the National Frequency Allocation Plan no new assignments are made, respectively no new radio licenses are delivered, until the end of validity of the previous radio licenses assigned in this frequency band (the end of validity can be due to expiration, non-usage of the frequency, etc.). The same is valid as far as a change in frequency usage (same "service" - other standard) is concerned. This is due to the fact that for certain frequency bands Notes on Frequencies, which, as annexes, are part of the National Frequency Allocation Plan, lay down the equipment category and/or the usage.

Nota bene: In Switzerland by law every frequency assignment must be consistent with the National Frequency Allocation Plan. Accordingly, although the law does not *per se* preclude the implementation of frequency refarming through private corporations/persons, the variety of choice for the services is limited (to the maximum the services allocated to the frequency band in cause in Article S5 of the Radio Regulation). Moreover there are formal boundaries should private corporations/persons be authorised to undertake frequency refarming (see *infra*).

Spectrum trading: Legal framework is at disposal but has not been used yet

In Switzerland the transfer of radio licenses is not *a priori* excluded. In the third Chapter of the Law on Telecommunications regulating radiocommunications, Article 27 refers to Article 9, which is dealing with the transfer of licenses. Article 9 foresees that "the transfer of whole or part of a license is only possible with the consent of the licensing authority". From a procedural point of view the previous consent of the licensing authority will always be necessary. In consequence, spectrum trading is possible in Switzerland. It is highly likely that the new assignee has a right to have the radio license transferred if he fulfils the conditions for the acquisition of a radio license as laid down by the law (Article 23 Law on Telecommunications).

However, despite being possible, the scope of spectrum trading is a very limited one. In the conception of the legislator only the assignee will change. But, although there is room for interpretation (for example a limited change of standard or usage), there is little room for a modification of the frequency allocation.

Moreover, the instrumental framework has not yet been implemented. Especially, publicly accessible databases of assignments and of prices and conditions of the various spectrum trades which have been approved by the authority are still missing. Though it has been recognised that such transparency is an essential element for spectrum trading to work efficiently.

Compensation: General rules of administrative law

Should it be necessary for the administration to modify the allocation and assignment of a frequency band in the National Frequency Allocation Plan before the expiration of the radio licenses in this band, the general rules of administrative law for the compensation of a damage occurring because of the revocation by the administration of a decision are applied. In particular, in the third Chapter of the Law on Telecommunications regulating radiocommunications, Article 27 refers to Article 10 dealing with the modification of licenses by the licensing authority. Paragraph 2 of Article 10 foresees the possibility of an indemnification of the licensee in such a case.

In any case the money will not flow from a special fund consisting of part of the radio licenses but from the general budget of the State. Similarly, the reimbursement of the amount of money paid by the State cannot be required subsequently from the new spectrum user.

Summary

There are no plans at present to diminish noticeably the role of the authority in charge of spectrum management in case of modifications in spectrum allocation or usage – in particular in the framework of spectrum trading. However, the legislator granted the spectrum management authority with a flexible legal framework regarding transfers of ownership of assignments.

ANNEX II : DETAILED RESULTS OF QUESTIONNAIRE ON REFARMING

1- SUMMARY OF FINDINGS

Response rate
A questionnaire on Refarming was sent out by ERO to CEPT Administrations 14 January 2002. Out of the 44 CEPT Administrations, 19 have replied to the questionnaire. These countries were:

1) Austria (A)
2) Bulgaria (BG)
3) Cyprus (CY)
4) Czech Republic (CZ)
5) Denmark (DK)
6) Estonia (EST)
7) Finland (FI)
8) France (F)
9) Germany (D)
10) Hungary (H)
11) Ireland (IRL)
12) Italy (I)
13) Latvia (LV)
14) The Netherlands (NL)
15) Poland (PL)
16) Portugal (P)
17) Sweden (S)
18) Switzerland (CH)
19) United Kingdom (GB).

Annex - Questionnaire evaluation

REFARMING PROCESSES	
Question 1. **Over the last years many new services were introduced, which made refarming of the bands necessary, for example: PMR 446, GSM 900 and 1800, UMTS, Digital TV, T DAB and WLL. In many countries the only refarming instrument that can be used at the movement is licence revoking. Has your Administration used any other instrument besides licence revoking in order to introduce these new services?**	
No, because the frequencies were not in use	**A** – because the frequencies were not in use or licences were revoked. **CY**
If other reasons, please state which…	**CZ** - Frequencies used without licence. **EST** - UMTS frequencies were under operation by fixed service stations. **S** – the licences have been revoked in good time and according to law. **GB** - Moved from military to civil use.
Yes	**BG, CZ, D, FI, F, H** (EXCEPT FOR WLL), **I, IRL, LV, NL, P, PL, CH**
If yes, could you indicate the refarming measures that were undertaken for each of the listed applications in your country, using licence revoking, licence expiry or any other instruments.	
PMR 446	**P** - No, because the frequencies were not in use. **CH** - No, because the frequencies were not in use. **GB** – Existing users were required to interleave with PMR 446 frequencies.
Licence expiry	**D** – The frequencies were used by Deutsche Telekom on an interim basis for Wireless Local Loop applications in order to provide basic telephone service in the so-called ”New Federal States of the Federal Republic of Germany” after the reunification of Germany in 1990. The frequency assignments were granted for a limited time. After expiration of the frequency assignments PMR 446 was introduced. It took several years.
Licence revoking	**A** – PMR, 1 year. **S** – military – approx. 3 years.
Retuning of equipment	**DK** - Existing PMR-users were informed of the introduction of PMR446. They were offered alternative frequencies, but were not forced out of the frequency band. - Less than a year. **I** **LV** – Radio links – not finished yet.
Voluntary withdrawal of the incumbent users	**BG** – military. **DK** - Existing PMR-users were informed of the introduction of PMR446. They were offered alternative frequencies, but were not forced out of the frequency band. - Less than a year. **FI** – military – frequencies for PMR 446 were made available immediately after the publication of the relevant ERC Decisions. **IRL** - State Services fixed links – 3 years.

Voluntary withdrawal of the incumbent users continues	**LV** – Radio links – not finished yet. **NL** – The military users were prepared to free 100 kHz. Some military applications (land mobile use) had to adjust to other frequencies, which were offered by the government. – Approximately 3 months. **PL** – military.
Voluntary withdrawal of the incumbent users	
Compensation by a refarming fund	**F** – About 250 small PMR networks and a part of the French national railway (SNCF) network were asked to move -The refarming process took 1 year.
Compensation by the new user	
Other instrument	**CZ** – Agreement with military users. GL issued (GL-3/R/2000). **D** – The frequencies were used by Deutsche Telekom on an interim basis for Wireless Local Loop applications in order to provide basic telephone service in the so-called ”New Federal States of the Federal Republic of Germany” after the reunification of Germany in 1990. The frequency assignments were granted for a limited time. After expiration of the frequency assignments PMR 446 was introduced. It took several years. **FI** – The publication of the required changes in the national allocation table long in advance. **F** – agreement between the incumbent users and administration dealing with spectrum. - About 250 small PMR networks and a part of the French national railway (SNCF) network were asked to move -The refarming process took 1 year. **H** - shared frequency usage on the basis of an agreement between the governmental (military) and civil frequency management entities. It did not take time.
GSM 900	**A** - The frequency band was free (except 2x1 MHz for CT1).
Licence expiry	**CH** - the incumbent operator was using part of the bandwidth for NMT-900 analogue mobile telephony. The spectrum management authority waited for his licence to expire) (incumbent operator, Military, users of licence-free equipment – up to 10 years). **DK** - Most of the GSM900 frequency bands were empty, when GSM was introduced. NMT900 has only occupied up to 2x10 MHz in the 900 MHz range. The NMT900 licence expired by October 2002. The licence holder of NMT900 has however decided to return their licence by 1. March 2002 and all frequencies are now available for GSM. - The decision not to extend the NMT900 licence was taken two years ago. Hence, the whole process to transfer NMT-frequencies to GSM has taken two years. **FI -** military, NMT, research – several years).
Licence revoking	**D** - The GSM 900 frequency range was used by military radio relay service all over Germany and in the former German Democratic Republic also by military aeronautical radionavigation services. Negotiations between relevant governmental authorities led to a long-term frequency utilisation concept with regard to the fixed

Licence revoking continues	service applications. Frequency compensation was provided in higher frequency bands for the military radio relay service. Equipment still remaining in the 900 MHz frequency range was retuned. The equipment in the aeronautical radionavigation service was retuned as far as possible on a step-by-step basis and phased out totally with the withdrawal of the relevant foreign military forces from the territory of Germany. Besides these military applications there was also a use by the first generation of cordless telephones (CT-1). The general frequency assignment for this application was revoked some years ago by publication in the official gazette. For an interim period continuation of use was allowed. New possibilities for CT have been offered (e.g. DECT). The negotiation processes between governmental authorities started years before GSM networks were opened. Spectrum was made available on a step-by-step basis for GSM. Over all more than a decade was needed. ***H** – various refarming methods have been used in different sub-bands. Military equipment has been retuned, revoking analogue FWA equipment (6 years) will be compensated by refarming fund, continuous licence revoking with regard to CT1 equipment (10 years). **LV** **NL** - NMT; ATF 3 – Originally the GSM 900 frequencies were reserved for military use. However, they did not use the frequencies. So there was no problem to prepare the frequency band for GSM 900. However, there existed a 'problem' with analogue NMT. The incumbent user KPN had an obligation to offer the service (ATF 3) until 1-1-96. As a result, in 1995 the situation was that there were three users in the 900 band. • GSM KPN; • GSM Libertel; • ATF 3 KPN. On the basis of a legal provision KPN had to finalised the use of ATF 3 so that these frequencies could be used for GSM. The ATF 3 frequencies had to be divided between KPN/GSM and Libertel/ GSM on the basis of market share. As a result the ATF 3 frequencies were given to KPN GSM for 60% and to Libertel for 40%. The ending of the use of ATF 3 in favour of GSM 900 took three years and was carried out in three steps: 1) first part was given back at 1-1 98 2) second part was given back at 1-7-98 3) the last part was given back at 1-10-99.
Retuning of equipment	**CZ** – several years **D** – The GSM 900 frequency range was used by military radio relay service all over Germany and in the former German Democratic Republic also by military aeronautical radionavigation services. Negotiations between relevant governmental authorities led to a long-term frequency utilisation concept with regard to the fixed service applications. Frequency compensation was provided in higher frequency bands for the military radio relay service. Equipment still remaining in the 900 MHz frequency range was retuned. The equipment in the aeronautical radionavigation service was retuned as far as possible on a step-by-step basis and phased

Retuning of equipment *continues*	out totally with the withdrawal of the relevant foreign military forces from the territory of Germany. Besides these military applications there was also a use by the first generation of cordless telephones (CT-1). The general frequency assignment for this application was revoked some years ago by publication in the official gazette. For an interim period continuation of use was allowed. New possibilities for CT have been offered (e.g. DECT). The negotiation processes between governmental authorities started years before GSM networks were opened. Spectrum was made available on a step-by-step basis for GSM. Over all more than a decade was needed). ***H** – various refarming methods have been used in different sub-bands. Military equipment has been retuned, revoking analogue FWA equipment (6 years) will be compensated by refarming fund, continuous licence revoking with regard to CT1 equipment (10 years).
Voluntary withdrawal of the incumbent users	**D** - The GSM 900 frequency range was used by military radio relay service all over Germany and in the former German Democratic Republic also by military aeronautical radionavigation services. Negotiations between relevant governmental authorities led to a long-term frequency utilisation concept with regard to the fixed service applications. Frequency compensation was provided in higher frequency bands for the military radio relay service. Equipment still remaining in the 900 MHz frequency range was retuned. The equipment in the aeronautical radionavigation service was retuned as far as possible on a step-by-step basis and phased out totally with the withdrawal of the relevant foreign military forces from the territory of Germany. Besides these military applications there was also a use by the first generation of cordless telephones (CT-1). The general frequency assignment for this application was revoked some years ago by publication in the official gazette. For an interim period continuation of use was allowed. New possibilities for CT have been offered (e.g. DECT). The negotiation processes between governmental authorities started years before GSM networks were opened. Spectrum was made available on a step-by-step basis for GSM. Over all more than a decade was needed. **DK** - Most of the GSM900 frequency bands were empty, when GSM was introduced. NMT900 has only occupied up to 2x10 MHz in the 900 MHz range. The NMT900 licence expired by October 2002. The licence holder of NMT900 has however decided to return their licence by 1. March 2002 and all frequencies are now available for GSM. - The decision not to extend the NMT900 licence was taken two years ago. Hence, the whole process to transfer NMT-frequencies to GSM has taken two years. **FI** - military, NMT, research – several years. **IRL** - Fixed links for broadcasting – a number of years. **P** - military, security forces – about 10 years. **PL** – military. **GB** - mainly military – up to 5 years

Spectrum pricing	
Compensation by a refarming fund	***H** - various refarming methods have been used in different sub-bands. Military equipment has been retuned, revoking analogue FWA equipment (6 years) will be compensated by refarming fund, continuous licence revoking with regard to CT1 equipment (10 years).
Compensation by the new user	**BG** - military – process to continue until 2004.
Other instrument	**CZ** - agreement with military users. **D** – The GSM 900 frequency range was used by military radio relay service all over Germany and in the former German Democratic Republic also by military aeronautical radionavigation services. Negotiations between relevant governmental authorities led to a long-term frequency utilisation concept with regard to the fixed service applications. Frequency compensation was provided in higher frequency bands for the military radio relay service. Equipment still remaining in the 900 MHz frequency range was retuned. The equipment in the aeronautical radionavigation service was retuned as far as possible on a step-by-step basis and phased out totally with the withdrawal of the relevant foreign military forces from the territory of Germany. Besides these military applications there was also a use by the first generation of cordless telephones (CT-1). The general frequency assignment for this application was revoked some years ago by publication in the official gazette. For an interim period continuation of use was allowed. New possibilities for CT have been offered (e.g. DECT). The negotiation processes between governmental authorities started years before GSM networks were opened. Spectrum was made available on a step-by-step basis for GSM. Over all more than a decade was needed. **FI** – the publication of the required changes in the national allocation table long in advance. **F -** agreement between military and administration dealing with spectrum in 1991. Military had to move – 5 years to free the GSM 900 band all over France. **CH** - part of the bandwidth was allocated to licence-free CT1 applications. The approach of the spectrum management authority was (a) not to grant a type approval to any new CT1 equipment and (b) announce that CT1 would not benefit anymore from protection against interference in the 900 MHz. (incumbent operator, Military, users of licence-free equipment – up to 10 years. Part of the bandwidth was allocated to MIL applications. This implied negotiations between the spectrum management authority and the military hierarchy.
GSM 1800	**A** - The frequency band was free.
Licence expiry	**FI** - military, FX – several years (continuous process, refarming synchronised with the development of the GSM 1800 network. **P** - radio licences: licence station, Military, Public Network operator – about 4 years. **CH** - The incumbent operator was using part of the bandwidth for fixed links. The spectrum management authority waited for his licence to expire – incumbent operator, military – up to 10 years.

Licence revoking	**FI** - military, FX – several years (continuous process, refarming synchronised with the development of the GSM 1800 network). **S** - telecom operator - approx. 5 years but in good time before GSM 1800 was launched. **P** - radio licences: licence station, Military, Public Network operator – about 4 years.
Retuning of equipment	**D** - in principal the same approach as for GSM 900 was applied. Mainly military usage had to be transferred into higher frequency bands by applying a long-term frequency utilisation concept agreed between governmental authorities. Spectrum for GSM 1800 was made available on a step-by-step basis).
Voluntary withdrawal of the incumbent users	**D** - in principal the same approach as for GSM 900 was applied. Mainly military usage had to be transferred into higher frequency bands by applying a long-term frequency utilisation concept agreed between governmental authorities. Spectrum for GSM 1800 was made available on a step-by-step basis. **DK** – the frequency band was used by the military until the introduction of GSM1800. A voluntary agreement was made with the military that they would vacate the frequency bands, when the GSM1800 service would be introduced. - About a year. **FI** - military, FX – several years (continuous process, refarming synchronised with the development of the GSM 1800 network). **IRL** - Fixed services telecom operators – 4 years. **NL** - KPN used the frequencies as fixed links for distribution/contribution (broadcasting) services in favour of NOZEMA (national transmitting operator). In 1993 there had been made an agreement that KPN had to free 2*25 MHz in 1998 and the rest of the frequencies in the year 2000. The distribution/-contribution broadcasting service should than be offered by fibreglass. However in the process to the preparation of the auction (auction took place in 1998) KPN decided to free the whole frequency band at that time (extra 2*50 MHz). - Originally in 2000 the whole frequency-band had to be free for GSM1800. As a result of the earlier voluntary retun of the frequencies of KPN in 1998 it took eventually 6 years. **P** - military, Public Network Operator – about 4 years. **PL** – military. **GB** - mainly military – up to 5 years.
Spectrum pricing	
Compensation by a refarming fund	**F** - ANFR fund since 1998. **H** - military equipment was removed – 1 year.
Compensation by the new user	**BG** - military – process to continue until 2004. **FI** - military, FX – several years (continuous process, refarming synchronised with the development of the GSM 1800 network. **F** - in 1994 the third GSM operator paid a special military fund for the first refarming works. Military was asked to move – about 4 years. **I** - military – a couple of years.

Other instrument	**CZ** - used without licence, by the incumbent operator. Cleared for GSM 1800 – FS – several years. **D** - in principal the same approach as for GSM 900 was applied. Mainly military usage had to be transferred into higher frequency bands by applying a long-term frequency utilisation concept agreed between governmental authorities. Spectrum for GSM 1800 was made available on a step-by-step basis. **FI** - the publication of the required changes in the national allocation table long in advance. **F** - agreement between military and administration dealing with spectrum in 1994 and 1998. Between GSM operators, administration (ART) organises an exchange of GSM 900 frequencies for GSM 1800 frequencies and vice versa. Military was asked to move - About 4 years. **CH -** Part of the bandwidth was allocated to MIL applications. This implied negotiations between the spectrum management authority and the military hierarchy.
UMTS	**A** - The frequency band was free. **S** - military – approx. 3 years and in good time before service was launched.
Licence expiry	**FI** - military, FX – several years (continuous process, refarming synchronised with the development of the UMTS network). **H** - Civil radio relay equipment is being removed with licence expiring method (4 years). **P** – radio licences: licence station - Public Network Operator – about 4 years. **CH** - In 1994 the Swiss Military put into service in the band concerned (2GHz) a new radio communication application. When the question of this application being removed from this band arose, the Military expected compensation. However, the spectrum management authority refused any compensation, since during the WARC-1992 it was decided to allocate the bands in question to the MOBILE service. Due to a lack of internal communication the Military introduced in this band following that conference the above mentioned new radiocommunication application. – incumbent oper ator – military – 5-7 years.
Licence revoking	**CZ** - no comment. **EST** - civil radio links about 3 years 1999-2002. **FI** - military, FX – several years (continuous process, refarming synchronised with the development of the UMTS network). **P** - radio licences: licence station – Public Network Operator – about 4 years. **S** – military – approx 3 years and in good time before service was launched.

Retuning of equipment	**D** - The phasing out of civil fixed service usage in order to open the bands for future mobile services was already agreed before 1990, when operator and regulator where within one and the same organisation, that means the former Deutsche Bundespost. This agreement was based on a long-term frequency utilisation concept and on the fact that there were own interests of former Deutsche Bundespost to open frequency bands for the mobile service. **DK** - Most of the frequency bands were empty. Only a few sporadic users of ENG/OB equipment had a licence in the UMTS bands. The users were offered alternative frequencies in the 2.3 GHz range. - 3 months). **H** - Military equipment will be retuned (4 years). **I** - Fixed links for transportation of broadcast signals – about one year.
Voluntary withdrawal of the incumbent users	**D** - The phasing out of civil fixed service usage in order to open the bands for future mobile services was already agreed before 1990, when operator and regulator where within one and the same organisation, that means the former Deutsche Bundespost. This agreement was based on a long-term frequency utilisation concept and on the fact that there were own interests of former Deutsche Bundespost to open frequency bands for the mobile service. **DK** - Most of the frequency bands were empty. Only a few sporadic users of ENG/OB equipment had a licence in the UMTS bands. The users were offered alternative frequencies in the 2.3 GHz range. - 3 months. **FI** - military, FX – several years (continuous process, refarming synchronised with the development of the UMTS network. **NL** - Military use (fixed services) in 2 GHz. The military agreed to replace these fixed services by fibreglass, eventually to be finished in 2000. In 1992/1993 this agreement was made between the government and the military as a result of the WARC-92 agreement: the 2 GHz band should be cleared for use of IMT-2000 (in 1992 it was called FPLMTS).- 7 years. **IRL** – Fixed Links – telecom operators – 3 years. **P** – Public Network Operator – about 4 years. **PL** – military. **GB** – Fixed Links.
Spectrum pricing	
Compensation by a refarming fund	**F** – Military, France Telecom and EDF (French national electricity provider) were asked to move. ***About 7 years to free the core frequency bands all over France.***

Compensation by the new user	**CH** - In 1994 in the bandwidth concerned (2GHz) the Swiss Military put into service a new radio communication application. When the question of this application being removed from the band in question, the Military expected compensation in order to abandon the band. However, the spectrum management authority refused any compensation as the Military clearly made a mistake when putting into service this application. Indeed, one of their representatives was member of the Swiss delegation at the WARC-1992 which decided to allocate the bands in question to the MOBILE service. So the Military should to the latest have avoided this band following that conference for setting into service new radiocommunication application. – incumbent operator – military – 5-7 years.
Other instrument	**D** - The phasing out of civil fixed service usage in order to open the bands for future mobile services was already agreed before 1990, when operator and regulator where within one and the same organisation, that means the former Deutsche Bundespost. This agreement was based on a long-term frequency utilisation concept and on the fact that there were own interests of former Deutsche Bundespost to open frequency bands for the mobile service. **FI** - the publication of the required changes in the national allocation table long in advance - military, FX . **F** - agreement between the incumbent users and administration dealing with spectrum. The new users reimburse the refarming fund. Military, France Telecom and EDF (French national electricity provider) were asked to move. About 7 years to free the core frequency bands all over France. **CH** - Part of the bandwidth was allocated to MIL applications. This implied negotiations between the spectrum management authority and the military hierarchy.
Digital TV	**F** - We are investing this matter at the moment. **CH** - has not yet been introduced in Switzerland. **GB** - Digital TV has been introduced in interleaved spare frequencies within the spectrum used for analogue TV.
Licence expiry	**DK** - When terrestrial DVB will be introduced in Denmark this will take place in existing broadcasting frequency bands. Existing analogue tv-stations will be affected by the introduction of DVB. Some analogue stations will need to change frequency, others will have to close to transmit in digital only. No other service than broadcasting services will be affected. - The process has not taken place yet. **I** – analogue broadcast – unknown because the process is not yet started and is not foreseen to start before 2006. **NL** - For DAV licences. In general the planned DVB-T frequencies were not in use and were available for DVB-T. In the future analogue TV has to be removed for nation-wide coverage of DVB-T (extra frequencies). For that reason the conference Stockholm 61 rev is now prepared. The first meeting is scheduled in 2004. The only 'problem' that had to be taken care of was the use of DAV (SAB/SAP). Some channels for (the future) DVB-T planning were/are in use for SAB/SAP. For that reason the SAB/SAP licences were set at a maximum of 5 years (the latest expiry date on 31 December 2005). Also the new and the old users made a 'gentlemen's-agreement' that in case the DVB-T operator wants to use the SAB/SAP frequencies earlier than 2005 (channel 41) a compensation

Licence expiry continues	has to be paid to the SAB/SAP operators on the basis of a mutual agreement on the price between the DVB-T operator and the old user. However, again, this is not foreseen in the DVB-T planning (the DVB-T licence holder has stated it does not need the channel 41 frequencies before the year 2005). - In theory 5 years for SAB/SAP, but in practice this has no meaning. **P** – radio licences: STL – Studio Transmitter Links – Public Network operator, Sound Broadcasting Operators (local coverage): STL links – about 2 years.
Licence revoking	**CZ** - several years. **DK** - When terrestrial DVB will be introduced in Denmark this will take place in existing broadcasting frequency bands. Existing analogue tv-stations will be affected by the introduction of DVB. Some analogue stations will need to change frequency, others will have to close or transmit in digital only. No other service than broadcasting services will be affected. - The process has not taken place yet.
Retuning of equipment	**A** – Public Broadcaster (ORF)- still ongoing. **CZ** – several years. **DK** – When terrestrial DVB will be introduced in Denmark this will take place in existing broadcasting frequency bands. Existing analogue tv-stations will be affected by the introduction of DVB. Some analogue stations will need to change frequency, others will have to close or transmit in digital only. No other service than broadcasting services will be affected. - The process has not taken place yet.
Voluntary withdrawal of the incumbent users	**A** – Public Broadcaster (ORF)- still ongoing. **FI** – analogue broadcasting – continuous process, refarming synchronised with the expansion of the digital network. **H** – voluntary withdrawal of military equipment (7 years) is in the process. **PL** (military)
Spectrum pricing	
Compensation	**P –** STL Links
Compensation by the new user	**NL** - In case the DVB-T operator wants to use particular DAV frequencies earlier than 2005, which is not foreseen or planned. In general the planned DVB-T frequencies were not in use and were available for DVB-T. In the future analogue TV has to be removed for nation-wide coverage of DVB-T (extra frequencies). For that reason the conference Stockholm 61 rev is now prepared. The first meeting is scheduled in 2004. The only 'problem' that had to take care of was the use of DAV (SAB/SAP). Some channels for (the future) DVB-T planning were/are in use for SAB/SAP. For that reason the SAB/SAP licences were set at a maximum of 5 years (the latest expiry date on 31 December 2005). Also the new and the old users made a 'gentlemen's-agreement' that in case the DVB-T operator wants to use the SAB/SAP frequencies earlier than 2005 (channel 41) a compensation has to be paid to the SAB/SAP operators on basis of a mutual agreement on the price between the DVB-T operator and the old user. However, again, this is not foreseen in the DVB-T planning (the DVB-T licence holder has stated it does not need the channel 41 frequencies before the year 2005). - In theory 5 years for SAB/SAP, but in practice this has no meaning.

Other instrument	**D** – Digital TV on a terrestrial basis (DVB-T) is to be introduced in bands already used by TV (only a few new channels available). The ”refarming process” is a rather complicated issue. There will be a simulcast transmission period and analogue TV is planned to be switched off by 2010. This has been decided by the federal government. **IRL** - Chester agreement – broadcasters – 4 years. **P** – Compensation (STL links).
T DAB	**F** – the introduction of this service is not yet decided. **GB** - VHF spectrum was found with bands designated in GB for advanced mobile services. Spectrum was formerly used for TV Broadcasting but reallocated for mobile. Some military VHF spectrum also used at MoD’s direction. L-Band spectrum for T.DAB is currently used by Fixed links which have rights of tenure until 2007. At the moment, there is no intention to use refarming tools to accelerate the date.
Licence expiry	**A** – private users of FX-links – 7 years. **NL** - for SAB/SAP users and radio security systems for military use. As a result of Wiesbaden 95 TV channel 12 was reserved for T-DAB in the Netherlands. TV Channel 12 was originally in use of the military but they agreed to free the band for T-DAB. This agreement was a general agreement at NATO level. In channel 11 there also was some SAB/SAP use and radio security systems use: • SAB/SAP use was removed by setting a maximum licence duration at 5 years (latest expiry in 2001). Radio security systems for military use was ended in band 3 by offering the military alternative frequencies. The whole operation has taken 5 years (from Wiesbaden 95 until now). **CH** - There were fixed links in operation in the band concerned. The spectrum management authority waited for the radio licences to expire – public authorities – 5 years.
Licence revoking	**A** – private users of FX-links – 7 years. **CZ** - several years. **S** – power companies in L-band – in progress will be finalised 2004.
Licence revoking	**A** – private users of FX-links – 7 years. **CZ** - several years. **S** – power companies in L-band – in progress will be finalised 2004.
Retuning of equipment	**CZ** - several years **D** – According to the Wiesbaden 95 Arrangement T-DAB is introduced in VHF channel 12 which has been made available in Germany through a national consensus finding process between parties concerned. Former usage – analogue TV) has been switched off. At 1.5 GHz military usage has to be moved to other frequency bands or equipment to be retuned. It took several years). **P** – frequency band: 219-230 MHz – television broadcasting operators, military. Frequency band: 1452 –1492 MHz – public network operators, private network operators – about 2 years.

Voluntary withdrawal of the incumbent users	**D** – According to the Wiesbaden 95 Arrangement T-DAB is introduced in VHF channel 12 which has been made available in Germany through a national consensus finding process between parties concerned. Former usage (analogue TV) has been switched off. At 1.5 GHz military usage has to be moved to other frequency bands or equipment to be retuned. It took several years. **DK** - The T-DAB frequencies were previously used by the military. The frequencies were made available for T-DAB use on a voluntary basis. About a year. **FI** – analogue, BC, Mil, FX, SRD – several years (continuous process, refarming synchronised with the development of the digital network. **H** – voluntary withdrawal of military equipment for temporary experiments. **IRL** - Fixed links used by telecom operators, local authorities and state services – 4 years. **I**, **NL** - originally users of band 3 for T-DAB: TV Channel 12 for military use. As a result of Wiesbaden 95 TV channel 12 was reserved for T-DAB in the Netherlands. TV Channel 12 was originally in use of the military but they agreed to free the band for T-DAB. This agreement was a general agreement at NATO level. In channel 11 there also was some SAB/SAP use and radio security systems use: • SAB/SAP use was removed by setting a maximum licence duration at 5 years (latest expiry in 2001). • radio security systems for military use was ended in band 3 by offering the military alternative frequencies. The whole operation 5 years (from Wiesbaden 95 until now. **P** – frequency band: 219-230 MHz – television broadcasting operators, military. Frequency band: 1452 –1492 MHz – public network operators, private network operators – about 2 years. **PL** – military.
Spectrum pricing	
Compensation by a refarming fund	
Compensation by the new user	
Other instrument	**D** – According to the Wiesbaden 95 Arrangement T-DAB is introduced in VHF channel 12 which has been made available in Germany through a national consensus finding process between parties concerned. Former usage (analogue TV) has been switched off. At 1.5 GHz military usage has to be moved to other frequency bands or equipment to be retuned. It took several years.
YES, if other reasons, please….	**CH** - The national public Broadcaster was using these frequencies for his own use (TV Analogue). As he was pressing in order to be allowed to start with the test phase for T-DAB, there was no need for any negotiations implicating the spectrum management in order to refarm the band in question.

WLL	**A** – 26 GHz band was free. **D** – The spectrum was de facto available as the former fixed service usage at 2,6 and 3,4 GHz reached the end of its life-time. The spectrum at 26 GHz used for WLL was not in use before. It took several years. **DK** - No refarming was done. All frequencies were empty prior to use for FWA. - N/A. **P** – No, because the frequency band were not in use. **CH** - In Switzerland WLL allocation both in 3.4 GHz and 26 GHz bands. No refarming because sharing was possible.
Licence expiry	**CZ** – several years. **FI** - FX – several years.
Licence revoking	**CZ** - several years. **S** - 3,4-3,6 GHz – telecom operator – In progress admin. decision appealed.
Retuning of equipment	
Voluntary withdrawal of the incumbent users	**A** - in 3,5 GHz band, military, 20 years. **FI** - FX – several years. **IRL** - fixed point to point radio links – 3 years for immediate requirements, new bands still being cleared. **NL** - KPN (fixed links). KPN co-operated to free the frequencies because the general idea at that time was that fixed links should be replaced by fibre as much as possible. Eventually KPN tried to get compensation for the frequencies (555.000 Euro), but when it was clear that the government had no intention to co-operate in any way on that point, they agreed very easily to give up the frequencies voluntary, without compensation. Three years (from 1998 until 2001). **PL** – military. **GB** - below 10 GHz – military/home office 10 GHz, Police - speed meters, about 12-18 months.
Spectrum pricing	
Compensation by a refarming fund	
Compensation by the new user	**F** - France Telecom and TDF (French national broadcaster) had to move. About one year. **GB** - at 10 GHz.

Other instrument	**FI** - the publication of the required changes in the national allocation table long in advance. **F** - agreement between the incumbent users and administration (ART) dealing with spectrum. France Telecom and TDF (French national broadcaster) had to move.
If other reasons	…. in 3.4 GHz and 26 GHz bands implementation by sharing was possible.
Are there any spectrum refarming process you consider worth highlighting ?	**D** - Analogue cellular mobile telephone network (so called "C-NET": 450.0-455.74 and 460.0-465.74 MHz) was switched off end of 2000. At the present Reg TP is drawing up the relevant part of the Frequency Usage Plan including these frequencies. Procedure see appendix 3 re question 2 (FreqNPAV). **It is important to set up and maintain long-term spectrum strategies in order to avoid complicated and difficult spectrum refarming processes.** **DK** - Voluntary withdrawal of the incumbent users. The NTA would as far as possible use this procedure. **F** – The spectrum refarming for UMTS is a good example of a complex process realised in compliance with the timetable determined by the European harmonisation. Between 1998 and 2001, seven conventions were concluded with the incumbent users in order to free the frequency bands. To free the core frequency bands all over France, refarming works began in 1999 and will end in 2004. **NL** – In case, in the (near) future a quick refarming process is needed for new applications, it is not expected that voluntary withdrawal, as was normal practice until now, can be applied that easily again and it is expected that compensation is probably needed in the future, taken into account the value of the frequencies which has been revealed in several auction processes. **P** – Option for the frequency band 3600-3800 MHz due to harmful interference in the band 3400-3600 caused by Military radio station (radiodetermination service. **PL** – compensation by a refarming fund **CH** - ERMES, refarming via retuning of equipment. TFTS, refarming via licence expiry: the incumbent operator was using part of the band for Fixed Links. The spectrum management authority waited for his licence to expire

LEGISLATION	

Question 2. **Are there legal rules (law, regulations, administrative ordinances) in your country, which prescribe how spectrum refarming has to be carried out?**	
No	**A, CY, IRL, LV, NL -**See clarification in question 3, **PL, S, CH** – the procedure for refarming is flowing from the general principles of administrative (public) law, whether settled in a law or flowing from jurisprudence, **GB**
Yes	**BG, CZ, D, DK, EST, FI, F, H, I, P**
If yes, please describe:	
	BG - Council for Radio Spectrum Policy. **CZ** - TL No. 151/2000 Coll., §60 and §61. **D** - Statutory provisions are in place in Germany which concern refarming mechanisms. A distinction should be made in this connection between refarming tools at the planning level and refarming with the framework of frequency assignment. Attention is drawn in this connection to the comments made in RegTP's contribution (reference 212e B 5000/031 noe/214-3 B 180) dated 17 September 2001 (attached as appendix 1 re question 2) and to the statutory instruments underpinning these refarming tools (also attached as appendixes 2-4 re question 2 (although requested in question 3)). Refarming tools at the planning level. The statutory basis providing for amendments to the national Table of Frequency Allocations is section 45(1) sentence 1 of the Telecommunications Act (Appendix 2), which empowers the federal government to amend the Table by statutory ordinance not requiring the consent of the Bundesrat. . The statutory basis for amendments to the national Frequency Usage Plan is section 9 of the Frequency Usage Plan Ordinance (Appendix 3), which states that the procedures for drawing up the Plan as described in sections 4 to 8 of he Ordinance apply accordingly to amending subplan are not affected by an amendment. In such cases, the holders of frequency assignments affected by the amendment and the supreme federal and state authorities must, with the participation of the Federal Ministry of Economics and Technology, be given a reasonable period of time for written comment. Refarming with the framework of existing frequency usage. The duration of an authorisation for usage (frequency assignment) can be restricted through secondary conditions attached to the frequency assignment under section 7(2) of the Frequency Assignment Ordinance. In accordance with section 36 of the Administrative Procedures Act (Appendix 4), these secondary conditions may take the form of a time limit, a revocation proviso or a condition subsequent. However, the authority is also able to annul the frequency assignment through revocation in certain cases as specified in the Telecommunications Act, the Frequency Assignment Ordinance and the Administrative Procedures Act. Section 47(5) sentence 3 of the Telecommunications Act provides for the revocation of a frequency assignment where use of the assigned frequency for its intended purpose is not commenced within one year of the assignment being granted or where the assigned frequency has not been used for its intended purpose for more than one year. Section 8 of the Frequency Assignment Ordinance specifies various cases where revocation is justified. A frequency assignment may, for instance, be revoked where one of the applicable preconditions ceases to exist (section 8(1) paragraph 1), where the holder of the assignment repeatedly violates or, in spite of repeated requests, fails to meet an obligation arising from the assignment (section 8(1) paragraph 2), and also where competition or the introduction of new frequency-efficient techniques is prevented or unreasonable hindered by a scarcity of frequencies arising after the assignment (section 8(1) paragraph 3). In addition, section 8(2) of the Ordinance provides for revocation where the relevant approvals granted under broadcasting law by the competent state authority ceases to apply. Furthermore, for the purposes of the introduction of digital broadcasting, section 8(3) of the Ordinance provides for the revocation of frequency assignments granted for analogue broadcast transmissions on the basis of broadcasting regulations. Section 49 of the Administrative Procedures Act specifies further, general cases justifying the revocation of frequency assignments.

	DK - Act No. 394 of 10 June 1997 on radiocommunications and Assignment of Radiofrequencies, revised in Act No. 1011 of 23 December 1998 and Act No. 1096 of 29 December 1999. A replacement of Act No. 394 by a new Act is expected in 2002. Generally frequencies are assigned by the National Telecom Agency on the basis of the "first come first serve" principle. However, in areas of the frequency spectrum where there is scarcity of frequencies this principle gives way to one or more frequency administrative methods. The Act lists the frequency administrative methods as: public tendering, administrative redistribution, requirements for changeover to more frequency effective methods of utilisation or technologies, requirements for restriction on usage, administrative withdrawal, enhanced administrative fixed pricing and enhanced frequency fee. Finally, the latest addition to the list of frequency administrative methods is auction. The following methods can be used alone or in a combination in order to release frequencies, eventually for new services: **Licence revoking** 1) **Administrative withdrawal,** a process similar to the process that is referred to in the questionnaire as licence revoking, assigned frequency resources within parts of the frequency plan are revoked before expiry of the relevant individual frequency licences. 2) **Administrative redistribution,** a process of licence revoking followed by a new assignment of frequencies to new and existing users or services, **Restrictions related to the use of the frequencies** 3) **Requirements for changeover to more frequency effective methods of utilisation or technologies**, requirements may be made for changeover to more frequency effective methods of utilisation or technologies before expiry of the relevant individual frequency licences, *(The method has not been used).* 4) **Requirements for restriction on usage**, requirements may be made for restriction on the use of assigned radio frequencies before expiry of the relevant individual frequency licences, for example capacity demanding use of frequency may be restricted, *(The method has not been used).* **Financial incentive** 5) **Enhanced administrative fixed pricing**, the price is set in order to reflect the marginal value for the marginal user, *(The method has not been used).* 6) **Enhanced frequency fee,** the fee for a specific part of the radio spectrum is set higher than the fee normally would be set in order to encourage the users to move their use to other parts of the radio spectrum, *(The method has not been used)*. **Public tendering and auction** are methods to be used for assignment of frequencies. These methods may be used with one of the above mentioned methods for releasing frequencies. **EST** - Telecommunications Act (§22; 23; 70. **FI** - Radio Act of 16 November 2001. **F** – Please, see file ”Q-Refarming-France-a”. **H** – Paragraph 6 of Article 11 of Act XL of 2001 on Communications prescribes the compensation of the incumbent users if the National table of Frequency Allocation (NTFA) has to be changed. Government Decree 221/1999.(XII.29) Korm. on Establishing the NTFA contains strategy of spectrum use. According to the NTFA the period of spectrum refarming takes minimum 5 years, which guarantees that the licences expire. **I** - d.l. 1/5/1997 n. 115 and Law 1 luglio 1997 n.189. **P** – Decree-Law no. 151-A/2000, of 20 July (www.anacom.pt)

Question 3. **If yes, could your attach to this replay a copy of your national legislation regarding refarming? (Preferably in English):**	
Copy attached	**BG** - www.mtc.government.bg **CZ** – www.mdscr.cz **D** - see Appendixes 2 to 4 re Question 2. **DK** - The relevant sections on refarming from the Danish Act No. 394 of 10 June 1997 on Radiocommunication and Assignment of Radio frequencies, revised in Act No. 1011 of 23 December 1998 and Act No. 1096 of 29 December 1999 is attached. The Act can be found on the website of the National Telecom Agency: www.tst.dk. A replacement of Act No. 394 by a new Act is expected in 2002. **EST** – Telecommunications Act is available at the following location: http://www.tsm.ee/telecomact.html **FI** - Free translation from 8§ of the Radio Act by P.L.: The Finnish Communications Regulatory Authority may during the period of validity of the licence revise the licence conditions, if it is necessary because of a change in the radio frequency plan, the regulations concerning radio frequencies or international agreement, or if it is necessary to prevent or eliminate interference. (Explanation: Frequencies are stipulated in the licence and are therefore considered a licence condition. Consequently, the reasons stated in the Radio Act give us the legal possibility to change the licence holders frequencies. **F** - Article 14 of the Telecommunication Act of 1996 (law n° 96-659, 26 July 1996) (English version). The decree n° 96-1178, 27 December 1996, concerning the ANFR (French version; the English version will be sent later). The "national legislation refarming in France" (French version) gathers extracts of the French legislation and explanations relating to the Refarming Commission (CFRS) mandate. **H** - The extract of the Act referred in Question 2 is as follows: ”Frequency assignment and radio licence, reservation and assignment of identifiers: Article 11 (1) radio equipment, radio stations, radio networks and radiocommunications systems may – with the exception of cases specified by law – be installed on the basis of a frequency assignment licence, while radio equipment, radio stations and radio communications networks may be operated – with the exception of programme receiver devices – with a radio licence. The radio licence may be issued exclusively on the basis of a valid frequency assignment licence – except in the cases specified by law. General authorisation may be given by laws on the operation of certain radio equipment. (6) If a licence mentioned in paragraph (1) is revoked due to modification of NTFA or an international obligation promulgated by law, the licensee shall be entitled to compensation, up to the amount of decrease in the value of its property, to be paid from the state budget.” **I** - see attachments

	NL - Clarification on answer in question 2: Possibly the transferability of licences can accommodate the refarming process via the market. In Dutch Telecommunications Law transferability of licences is allowed *with permission of the Minister* (Article 3.8 TA). The reason not to give permission are limited summed up in article 3.6 of the Telecommunications Act. **Article 3.8** 1. A licence is not be transferable, unless an exemption for this purpose has been granted by Our Minister. 2. An exemption may be granted with restrictions. Regulations may be attached to such an exemption. These restrictions and regulations may be altered. Article 3.6 shall apply *mutatis mutandis* to the granting of an exemption within the meaning of the first paragraph. **Article 3.6** 1. Our Minister shall deny a licence if: a. the granting thereof is in violation of the frequency plan; b. this is required for an efficient use of the radio frequency spectrum; c. a licence has already been granted for use of the set of frequencies requested in the application, unless shared use of sets of frequencies is possible; d. it has been requested for the broadcasting of programmes for which no broadcasting time has been obtained under the Media Act, or, in so far as permission is required pursuant to the Media Act, such permission has not been granted; e. in the opinion of Our Minister, facts or circumstances indicate that the security of the State or public order could be jeopardised by granting the licence, or f. its granting would be in violation of the rules laid down by or pursuant to this Act, or by or pursuant to Article 82e or 82f of the Media Act. 2. Our Minister may deny a licence if: a. a licence granted earlier has been revoked due to violation of rules laid down by or pursuant to this Act or of the regulations attached to the licence; b. the applicant has not fulfilled the obligations resting upon it, arising from a previously granted licence; c. the application does not comply with the rules laid down by or pursuant to this Act, or d. granting of the licence to the applicant would significantly restrict real competition on the relevant market, provided that reasonable consideration will be given to legitimate interests with respect to the use of new technology. **In Dutch article 3.8 of the TA is explained in the following books (pages can be faxed if requested):** E.J. Dommering, N.A.N.M. van Eijk, J.A.M. Nijhof, M.l. Verberne, *Handboek Telecommunicatierecht; Inleiding tot het recht en de techniek van de telecommunicatie*, Iter, 1999. pp. 366-367. J.M.E. van Breugel, E.J. Daalder, *Telecommunicatierecht; De parlementaire geschiedenis van deTelecommunicatiewet*, SDU, Den Haag, 1999, pp. 179 t/m182. A.H.J. Schmidt, H. Franken, P.C. Knol, G.J. Zwenne, *Telecommunicatiewet; Tekst en commentaar*, Kluwer, Deventer, 2001, pp. 47-48.

Question 4. **If your administration does not have current legislation nor practice of dealing with spectrum refarming, are there any plans to develop such legislation or otherwise apply spectrum refarming in the near future?**	
No	**BG, DK, H, NL, PL, CH,**
Yes	**A, CY, D, FI, IRL, LV, S, GB**
If yes, please describe:	
	A - Revision of Telecom Act due to Telecom Review of EC discussion just started. **CY** - It is expected that the Parliament will vote on a new Radiocommunications law within the 1st quarter of 2002. **D** - As already shown in the answers referring to questions 1 to 3, Germany has practice of dealing with spectrum refarming as well as current legislation. Nevertheless, there are ideas to improve legislation. Reg TP will introduce proposals for the next draft amendment of the Telecommunications Act. Independent from an amendment of this Act, e.g. the spectrum 450.0-450.74 and 46.0-465.74 MHz can be refarmed using the existing legislation. **FI** – We intend to utilise the existing methods also in the future **IRL** - New Radiocommunications Act to replace Wireless Telegraphy act of 1926. **LV** – To regulate Spectrum refarming with secondary legislation. Could be developed according to results of ECC report on refarming issues. **S** - the existing Radiocommunications Acts is currently under investigation and the NPTA has drawn the Investigators attention to problems like refarming. **GB** - The United Kingdom is planning new legislation to implement the package of European Directives and to make other changes. It is expected to include measures for secondary trading.
Question 5. **Do you consider the instruments you have used until now adequate and efficient in relation to the time frame within which the introduction of the new services had to take place?**	
No	**A, D** - the instruments are not adequate and efficient in relation to the time frame and should be improved. A more flexible way of frequency refarming should be created. **I, PL, GB**
Yes	**BG, CY, CZ, DK, EST, FI, H, IRL, LV, NL, P, S, CH**
Please explain:	
	CY – No refarming was needed. **EST** – In accordance with Telecommunications Act the Estonian National Communication Board shall notify about this decision at lease two years in advance. We consider, that the instruments we have used until now are adequate and efficient. **FI** – They have worked well and generated good results so far. We have no reason to think that this would not be the case also in the future. **F** – With our national spectrum organisation, it is rather easy and fast to make a spectrum refarming decision because ANFR is in charge of the spectrum assignments and is also responsible for the spectrum refarming. The refarming fund, managed by ANFR, makes it possible to anticipate refarming works and thus to match the dates of moving of the old network/equipment and rolling out the new network/equipment. **NL** – The applications mentioned in the questionnaire were all dealt with very satisfactorily with regard to the refarming aspects. However, there is an assumption that in the future the voluntary withdrawal of frequencies based on mutual agreement between incumbent users and the government will possibly not take place so smoothly as was normal in the past, and it is expectedthat financial compensation has to be paid regarding the present notion of the value of the frequencies. **P** – Until now, all the new radiocommunications services have been introduced without any constraints on radio spectrum use, except in the case of WLL. **S** - By appropriate action the NPTA has been able to supply the bands necessary for the services mentioned. **CH** – First reflection in view of refarming of a band start as soon as – if not before – a WRC modifies RRS5 or preliminary work in view of ERC/DECs or ERC/RECs begins. Accordingly, the 5-10 years needed in order to refarm a band by mean of the usual instrument of licence expiry (eventually licence revoking but without compensation) were until now sufficient. **GB** – Current instruments prevent trading, and the ability to revoke a licence is sufficiently inflexible.

FUTURE PLANS

Question 6. **If there are any plans, could you describe what refarming mechanisms are foreseen by your national legislation.**	
Please describe:	**A** - revision of Telecom Act due to Telecom Review of EC discussion just started. **CY** – licence expiry & licence revoking. **D** - there are currently no fixed descriptions of new refarming mechanisms. **DK** – Please, see the description in Question 2. **FI** - not applicable. **H** - no plans. **IRL** - still awaiting legislation to deal with refarming. **CH** - no plans. **GB** - the UK foresees the use of secondary trading as the primary incentive for a more dynamic spectrum market. It will encourage potential applicants for new services to negotiate with existing users directly. Meanwhile there is also a continuing role for the State to plan for new spectrum use by band and to encourage clearance by a mix of incentives, through regulatory action and through trading.

FINANCIAL ISSUES

Question 7.
If you revoke a licence before the licence expiry date, is compensation paid to the user who has to leave the band

No	**BG, CY, DK, EST, FI*, IRL, I, PL, S, GB**
Yes	**A** **CZ** - According to the TL holder of the revoked licence has the right to ask state for compensation, **D, FI*, F, H, LV,** **NL** - in case of DVB-T, **P** **CH** - if the legal conditions flowing from the general principles of administrative law for a compensation are fulfilled.
if yes please explain::	**D** - No licence have been revoked to date. Attention is drawn to section 49(6) of the Administrative Procedures Act, which states that if an administrative act granting privileges is revoked under section 49(2) paragraphs 3 to 5 of the Act, the public authority must – upon request – compensate the party affected for any financial losses sustained as a result of his faith in the continuance of the administrative act, as far as this faith warrants protection. Section 48(3) sentences 3 to 5 of the Act apply accordingly to such compensation. Recourse to the ordinary courts is provided in the case of disputes about such compensation. ***FI** - in the case of GSM-1800 a compensation was paid by the new user to the incumbent. The amount was agreed in a negotiation between the users and the administration. **F** (In France, a licence is necessary for setting up a network (public or private) or providing services (telecommunication or broadcasting). If a licensee needs any frequencies, CSA (for broadcasting) or ART (for telecommunication) assigns frequencies to him by a formal decision which is published in the official Gazette. Actually when a licensee is asked to leave a frequency band, it is not necessary to revoke his licence. Administration can only abrogate the corresponding assignment decision and can assign him another frequency band. **NL** - Not in general, but in the particular case of DVB-T this agreement has been made in case the DVB-T operator wants to use the channel 41 frequencies earlier than 2005 (which is not foreseen).

Who determines the price that is going to be paid ?	**F** - The ANFR commission CFRS determines the refarming cost. **H** - Administration and users make an agreement on the compensation, taking into account the provisions of the Act referred in Question 2. **NL** - On agreement between the new user and the old user – (again in case of DVB-T). **CH** - It is the authority revoking the licence. The authority revoking the licence is the same as the one having granted the licence (”Formenparalelismus”). According to the type of licence, in Switzerland it is either the ComCom (Communications Commission) or OFCOM (Federal Office for Communications. **P** – the administration.
What criteria for compensation of the incumbent users are used ?	
Book value	**F, LV, CH**
Economic value	**F, H, P** - of the radio equipment
Other, please describe	**F** - the rate of capital remuneration relating to the incumbent user is taken into account
Who pays the compensation	**CH** - here compensation is understood in the narrow sense as the amount of money paid to repair a ”damage” **P** – the administration
The new user	**A** **F** - when he can be identified, by reimbursing the refarming fund, **LV** **NL** - in case of DVB-T, if needed
The administration	**F** **H** **P** **CH** - general budget of the State – accordingly tax payer’s money
Other, please explain	

Question 8. **May the State/Administration use a fund for refarming?**	
No	**A** **CY** - In general no refarming was needed so far. **CZ** **D** **DK** **EST** **IRL** **I** **LV** - Such a fund is not established. **NL** **P** **PL** **CH** - the money necessary for the compensation will come from the general budget of the State.
Yes	**BG** **FI** - There are no regulations that would prohibit the use of such fund. Our licence fees and frequency fees are collected only to cover the costs. Maintaining a fund would imply an increase in the fees. **F** **H** - According to the Act XL of 2001 on Communications there is not a separate refarming fund, but the sub-paragraphs b) and c) of 2 paragraph of Article 3 of Ministerial Decree 11/2001. (IV.24.) MeHVM on ”Regulation of use and management of estimate for informatics, telecommunications-development and frequency management” prescribe that the estimate (a part of the state budget) has to cover the compensations resulting from the change of NTFA (see question 2 above) and from other refarming tasks needed for the introduction of up-to-date telecommunications technology. **GB**

Question 9. **If yes, how is this fund financed?**	
• The new user pays the costs of relocating the old user, via the fund	
• The government pays the costs of relocating the old user to the fund	**H**
• A combination of the two	**F, GB**
• All licences contribute to the fund via a part of their licence fee	**BG**
• Other, please describe:	

SECONDARY TRADING

Question 10. **Secondary trading would permit users of frequencies to make private arrangements on transfer of spectrum using rights to other parties under certain conditions. Does your Administration have any plans to introduce secondary trading in order to assist in refarming?**	
No	**A** **BG** **CZ** **D** **DK** - Individual frequency licences cannot be taken over by other parties. It is however possible, in connection with the issue of individual licences to specific user groups, to take over and redistribute licences internally within such user group. Take-over of individual frequency licences is also possible between parent companies and wholly owned affiliated and subsidiary companies. However, restrictions on, or exclusion from, this right of take-over may be stipulated in regulations laid down in connection with a public invitation to tender, cf.section 6. **EST** - in accordance with Telecommunication Act §18 a technical authorisation is not transferable. **FI** - a bit difficult to see how secondary trading would assist refarming. **I** – no comments. **LV** - Not yet. Probably, in future. **NL** - ”No” because transferability is already allowed in Dutch Telecommunications Law (article 3.8 TA; see also the answer given in question 3 of the questionnaire. **P** **PL** - not yet. **CH** - however, by law the assignee of a licence can change without the licensing authority having first to retrieve the licence from the incumbent licensee (Art. 9 in connection with Art. 27 of the Telecommunications Act.
Yes	**CY, F, H, IRL, GB**
If yes, please describe the plans:	**CY** – on the condition of approval by the administration
	F - French Administration is studying this matter
	H - The act XL of 2001 on Communications gives possibility for secondary trading but in practice we do not have any experience
	IRL - New legislation to permit transfer of licences when sold as part of company assets, not intended to establish a spectrum trading market
	GB - see the consultation document on the RA website

LIST OF CONTACTS WHO HAVE PROVIDED INFORMATION

Contact information-Austria	
Name & first name	Lettner, Gerd
Organisation	DMVIT
Position	Head of Technical Department
Address	Kelsenstr. 7 - A-1020 Vienna
Telephone	+43 178731 –4200
Fax	- 4209
Email	gerd.lettner@bmv.gv.at
Web-site	

Contact information-Bulgaria	
Name & first name	Krassimira Havezova
Organisation	Communications Regulation Commission
Position	Director, "Licensing" Directorate
Address	6, "Gurko" Str., - 1000 Sofia, Bulgaria
Telephone	++359 2 949 2331
Fax	++359 2 949 2166
Email	Khavezova@crc.bg
Web-site	www.crc.bg

Contact information-Cyprus	
Name & first name	Mr. Komodromos, Georgios
Organisation	Ministry of Communications and Works
Position	Senior Telecommunications Officer
Address	28, Acheon Str. – 1101 Nicosia, Cyprus
Telephone	+357 22 800 201
Fax	+357 22 776 254
Email	g.komodromos@mcw.gov.cy
Web-site	

Contact information-Czech Republic	
Name & first name	OTÝPKA Jiří
Organisation	Czech Telecommunication Office
Position	Frequency spectrum manager
Address	P.O.Box 02, 225 02 Praha 025, Czech Republic
Telephone	+420 2 24004 673
Fax	+420 2 24004 823 or …824
Email	jiri.otypka@ctu.cz
Web-site	www.ctu.cz

Contact information-Denmark	
Name & first name	Robert Lindgaard
Organisation	National Telecom Agency
Position	Senior Adviser
Address	Holsteinsgade 63, 2100 Copenhagen Ø, Denmark
Telephone	+45 35 45 02 51
Fax	+45 35 45 00 16
Email	Rl@itst.dk
Web-site	www.itst.dk

Contact information-Estonia	
Name & first name	Jaak Jõesoo
Organisation	Estonian National Communication Board
Position	Head of Technical Planning Department
Address	Ädala 2, 10614 Tallinn, ESTONIA
Telephone	+372 693 11 87
Fax	+372 693 11 55

Email	jaak.joesoo@sa.ee
Web-site	

Contact information-Finland	
Name & first name	Pekka Länsman
Organisation	Finnish Communications Regulatory Authority (FICORA)
Position	Head of division
Address	Box 313, 00181 Helsinki, Finland
Telephone	+358 9 6966 424 (office) +358 50 65 424 (mobile)
Fax	+358 9 6966 410
Email	Pekka.lansman@ficora.fi
Web-site	www.ficora.fi

Contact information-France	
Name & first name	DELTOUR Catherine
Organisation	Agence Nationale des Fréquences
Position	Economic studies
Address	78 avenue du Général de Gaulle – BP 400 –94704 Maisons-Alfort Cedex FRANCE
Telephone	+33 (0) 1 45 18 73 95
Fax	+33 (0) 1 45 18 73 13
Email	Deltour@anfr.fr

Contact information-Germany	
Name & first name	Japes, Hubertus
Organisation	Regulatory Authority for Telecommunications and Posts
Position	Official in Section 214
Address	Postfach 8001, D-53105 Bonn, Germany
Telephone	+49 (0) 228-14-0 (exchange) Mr. Japes- 1253 (Extension)
Fax	+49(0)228-14-8872 (Central) Mr. Japes-6125(extension of section 214)
Email	Poststelle@regtp.de (central address) hubertus.japes@regtp.de
Web-site	www.regtp.de

Contact information-Hungary	
Name & first name	Ferenc Horvath
Organisation	Ministry of Informatics and Communications
Position	Head of Department of Radiocommunications
Address	Dob u.75-81, Budapest, H-1077 Hungary
Telephone	+36 1 461 3580
Fax	
Email	Ferenc.horvath@ihm.gov.hu
Web-site	www.ihm.gov.hu

Contact information-Ireland	
Name & first name	Samuel Ritchie
Organisation	ODTR
Position	
Address	Irish Life Centre, Lower Abbey Street, Dublin, Ireland
Telephone	+353 1 804 9619
Fax	+353 1 804 9671
Email	Ritchies@odtr.ie
Web-site	www.odtr.ie

Contact information-Italy	
Name & first name	Francesco TROISI
Organisation	Ministero delle comunicazioni
Position	Dirigente
Address	Viale America, 202, I-00144 ROMA Italia
Telephone	+39 06 54442049

Fax	+39 06 5914249
Email	Troisi@comunicazioni.it
Web-site	Www.comunicazioni.it

Contact information-Latvia	
Name & first name	Daiga Janauska
Organisation	Latvia Telecommunication State Inspection
Position	Legal Adviser
Address	Elizabetes 41/43, Riga, LV-1010 Latvia
Telephone	+371 7332655 /+371 7333034
Fax	+371 7821275
Email	Lvei@latnet.lv and daiga@latnet.lv
Web-site	Http://www.vei.lv

Contact information-The Netherlands	
Name & first name	Arts, André
Organisation	Radiocommunications Agency Netherlands
Position	Senior Economist
Address	Emmasingel 1, P.O. Box 450, 9700 AL Groningen
Telephone	+31 50 5877 217
Fax	+31 50 5877 400
Email	Andre.arts@at-ez.nl
Web-site	www.ivw.nl

Contact information-Poland	
Name & first name	Adam Brodziak
Organisation	Office of Telecommunications Regulation
Position	Head of the Frequency Management Department
Address	Kasprzaka Street 18/20, PL-01-211 Warsaw, Poland
Telephone	+48 22 608 8125
Fax	+48 22 608 8175
Email	a.brodziak@urt.gov.pl
Web-site	

Contact information-Portugal	
Name & first name	BARBOSA, José
Organisation	ANACOM – Autoridade Nacional De Comunicacões
Position	Adviser
Address	Av. José Malhoa, 12, P-1099-017 LISBOA, Portugal
Telephone	+ 351 21 721 22 12
Fax	+ 351 21 721 10 06
Email	jose.barbosa@anacom.pt
Web-site	www.anacom.pt

Contact information-Sweden	
Name & first name	Kjellin, Per
Organisation	NPTA
Position	Head of division
Address	PO Box 5398, S-102 49 Stockholm, Sweden
Telephone	+46 8 6785575
Fax	+46 8 6785506
Email	Per.Kjellin@pts.se
Web-site	www.pts.se

Contact information-Switzerland	
Name & first name	von der Emden, Dirk-Oliver
Organisation	OFCOM (Swiss Federal Office for Communication)
Position	Legal Adviser
Address	44, rue de l'Avenir, CH-2503 Biel-Bienne,Switzerland

Telephone	+41 32 327 57 04
Fax	+41 32 327 56 66
Email	Dirk-olivier.von-der-emden@bakom.admin.ch
Web-site	http://www.bakom.ch

Contact information-United Kingdom	
Name & first name	Thomas, David
Organisation	Radiocommunications Agency
Position	Manager of Central Licensing Unit
Address	Wyndham House, 189 Marsh Wall, South Quay, London, E14 9SX.
Telephone	020 7211 0182
Fax	020 7211 0118
Email	David.thomas@ra.gsi.gov.uk
Web-site	www.radio.gov.uk

ANNEX III : USE OF SCENARIOS TO ASSIST THE DECISION MAKING PROCESS

Scenario Planning methodology
Scenarios resemble a set of stories, built around carefully constructed plots. Stories are an old way of organising knowledge; when used as strategic tools, they confront denial by encouraging the willing suspension of disbelief. Stories can express multiple perspectives on complex events; scenarios give meaning to these events.

Scenarios are powerful planning tools precisely because the future is unpredictable. Unlike traditional forecasting or market research, scenarios present alternative images instead of extrapolating current trends from the present. Scenarios also embrace qualitative perspectives and the potential for sharp discontinuities that econometric models exclude.

Scenarios provide a common vocabulary and an effective basis for communicating complex –sometimes-paradoxical – conditions and options. Good scenarios are plausible and surprising. Using scenarios is rehearsing the future. By recognising the warning signs and the drama that is unfolding, one can avoid surprises, adapt and act effectively. Decisions which have been pre-tested against a range of what fate may offer are more likely to stand the test of time, and produce robust and resilient strategies. Ultimately, the result of scenario planning is not a more accurate picture of tomorrow, but better thinking and an ongoing strategic conversation about the future.

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

One of the key drivers affecting changing demand for spectrum, and hence the need for refarming, is the process of convergence. Telecommunications, broadcasting and computing are coming together using a common digital technology and language. New services are becoming possible as the boundaries between hitherto distinct technologies erode and disappear. In 2000, consultants generated a set of four scenarios to 'map the future' of convergence and spectrum management for the next decade. These were based on a programme of interviews with business and other key players and a two-day workshop with participants from across the communications industry, Government agencies and academia.

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

1. Internet Convergence

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

2. Digital Islands

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

3. Total Mobility

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

4. Broadband Revolution

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

The scenarios are not predictions. Nor are they mutually exclusive so they should not be regarded as options between which one needs to choose. They can co-exist and interact in a complex and dynamic way with relative dominance altering over time.

Each scenario implies a different pattern of demand for spectrum as illustrated in the following table XX.

	Internet Convergence	**Digital Islands**	**Total Mobility**	**Broadband Revolution**
Additional spectrum relative to now for: - Wide-area mobile - Short-range radio - Fixed wireless access - DVB-T	 ++ ++ + +	 + + ++ ++	 +++ ++ +++ 0	 + +++ ++ –
Speed of broadcasting/telecoms convergence	Moderate	Slow	Moderate	Fast
Speed of fixed/mobile integration	Slow	Slow	Fast	Fast

Key to the table:

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

Table: Differences Between Scenarios in Terms of Spectrum Demand

Some elements, such as the increase in demand for wide-area mobile, are common to one or more scenarios albeit to a differing degree. Others show significant differences, notably for video broadcasting. This underlines the importance of monitoring developments to provide indications of future trends so that the need for refarming can be anticipated and spectrum strategy can be adjusted in good time. This is especially important given the long lead times that can be needed to plan and execute refarming, especially if international coordination is required.

Conclusions on use of scenarios

Scenarios have an important role in providing insights into the drivers that are influencing the future. They can be of considerable value in spectrum planning at both allocation and assignment levels. For example, they can provide useful insights into:

- how convergence is affecting spectrum management;
- the implications for demand for spectrum;
- early warning of the need for refarming;
- the types of spectrum management tools that can be usefully employed.

From work to date undertaken on the application of scenarios to communications and spectrum management, the following conclusions can be drawn:

- With growing uncertainty and speed of change, it will become increasingly necessary for spectrum managers to be able to respond flexibly with more dynamic refarming.
- The erosion of historic boundaries between services makes it necessary to question whether existing ITU service definitions are sufficiently flexible. As convergence progresses, the nature of the transmissions, rather than content, should determine the use made of frequency bands.
- Opportunities for the release of spectrum for mobile use should be reviewed. No other medium can replicate the advantages of radio for mobile communication. It is important to ensure that spectrum that can be used for mobile applications is not reserved for other services that do not generate as much economic, social and consumer benefit.
- Market-based spectrum management tools, such as auctions and trading, offer important advantages. Regulators have imperfect information. Market participants are better informed and so are more likely to make decisions that maximise the benefits derived from spectrum. Market mechanisms are also, generally speaking, more dynamic and flexible than regulation. That is not to say that market-based tools will or should totally replace regulation. Regulation will continue to play an important role, for example to prevent interference, to ensure compliance with international obligations and to safeguard access to spectrum by essential public services. However, other tools will increasingly become needed. One example is auctioning ‘overlay licences’.

ANNEX IV: SPECTRUM TRADING IN NON-CEPT COUNTRIES

AUSTRALIA

The Australian Communications Authority (ACA) introduced spectrum trading in 1997 under the Radiocommunications Act 1992. Spectrum trading was introduced for two reasons. First, the ACA felt that businesses are better able to make decisions about technology selection and system design when providing services to the community, than Government. Second, the ACA believed that resources ought to be allocated to those who value them most, because those placing the highest value will deliver the most efficient outcome.

In Australia, there are two types of tradeable licences:

- *Spectrum Licences,* which are auctioned off and fully tradeable thereafter;
- *Apparatus Licences*, which are technology specific and site and service specific. A number of types of apparatus licences have been sold over the years.

The main challenges faced by the ACA were as follows:

- defining spectrum access rights in engineering terms;
- allocating and trading spectrum property, namely trading rules;
- managing the level of interference;
- management of spectrum and the secondary market;
- the transition from government to industry;
- having the ability to deal with legal and technical disputes.

Spectrum Licences

Spectrum licences were awarded for the first time in 1997, following the auction of the 500MHz band[28]. The ACA wanted to make a spectrum a general commodity and subsequently developed the concept of the Standard Trading Unit (STU); these are like building blocks. Spectrum space is thought of as a cube and covers a geographic area authorised by a licence[29]. The area is like the floor of the cube and the radio frequency bandwidth is represented by the height of the cube. STUs, can be stacked vertically to provide increased bandwidth or horizontally to cover a larger area. Ownership of an STU cannot be shared and this allows exclusivity of access to be preserved. Sharing is a matter for the access right holder to manage and not the ACA.

Spectrum licences can be aggregated or sub-divided to form new licences. Licensees who wish to trade part of a licence can disintegrate the licence into its component STUs and sell them individually or in multiples. A single STU is the smallest unit of spectrum space for which the ACA will issue a licence or register trading. The frequency bandwidth of STUs may vary in size depending on the spectrum band in which licences are being issued, but the area grid will be constant for all bands.

Competition

The Australian Competition Authority is responsible for any competition concerns regarding the acquisition of spectrum. So far the competition authority has not been faced with any significant competition concerns regarding the acquisition of spectrum. However, there is a concern that the introduction of intermediaries could encourage anti-competitive behaviour. This is because those interested in being intermediary players in spectrum trading, namely those interested in facilitating spectrum management leasing, are likely to be large incumbent users of spectrum. It is believed that the small users of spectrum would not be comfortable with the idea of leasing spectrum from incumbent users.

---

[28] A simultaneous ascending auction was held because it offered all spectrum allocations at the same time, over multiple rounds and stages. Consequently bidders could bid for allocations in particular combinations to suit their specific business plans.

[29] Australia shares few radiocommunications borders with its neighbours. Its population is concentrated into reasonably small and isolated pockets. Australia's demographic make-up enables the ACA to define market and radiocommunications service areas fairly clearly. Spectrum property concepts would need to be adapted to local conditions.

Availability of Information

The ACA maintains a searchable public on-line register of radiocommunications licences to facilitate trading[30]. There also exists an informal market of intermediaries, namely firms like Market Dynamics Property Ltd on www.market-dynamics.com.au.

Recently a private on-line spectrum trading desk has been established, by an Australian Merchant bank called Macquarie Bank[31]. The trading platform is the first centralised Australian secondary market to trade spectrum rights. The potential advantages of the system are that it could facilitate a secondary market by providing users with liquidity, confidentiality and market information. The main users are expected to be major telecommunications companies. The ACA remains the government authority responsible for issuing spectrum licences, although it supported the development of an on-line trading system.

NEW ZEALAND

In the New Zealand[32], a scheme of tradable spectrum property rights was adopted in late 1989 following the Radiocommunications Act 1989. The new regime was applied first in broadcasting where the perceived need for reform was greatest. The Act provides for two basic types of tradable spectrum rights:

- A *management right* over any defined frequency band, nation-wide and for a specified period (but limited to a maximum term of 20 years by the Act);
- A *licence right* by the owner (manager) of a management right for frequencies within the frequency band of the management right.

Management Rights

A management right may only be created by the Secretary of Commerce on behalf of the Crown[33]. The right will either be disposed of to the private sector or retained by the Government to issue licence rights (normally by tender and now by electronic auction through the Internet). A private sector holder of a management right can sell it or retain it and sell the associated licence rights to third parties.

Management rights cover a block of the radio spectrum and are not inherently use-specific. Management rights can be aggregated or sub-divided. They are traded on a similar basis as land and can be mortgaged. Holders of management rights pay no annual fee for those rights but will have paid through a tender process for the management right. They also have to pay a fee to the Ministry of Commerce (MoC) for any licence rights they issue to themselves and others. Management rights themselves do not confer the right to make any transmissions.

There were 41 management rights as at January 2001. The Government retains ownership of 15 of these rights including those covering the public broadcasting spectrum (radio and television). The Government issues licences according to a mix of commercial and social polices. The private sector owns 26 management rights, some of which are in the cellular telephone spectrum areas.

Licence Rights

Licence rights are use-specific and are defined in terms of transmitter sites. Transfer of ownership of a management right does not affect the licence right.

Licence rights have unwanted emission limits and maximum permitted interference limits. A defined floor level of -50dBW for noise is set in the legislation.

[30] www.aca.gov.au/publications/info/transfer.htm
[31] www.macquariebank.com
[32] www.med.govt.nz
[33] When management rights are created, existing apparatus licences in the band are entitled to a transitional right, which may be either a 5-year spectrum licence (without payment) or a 20-year spectrum licence (for which a fee is charged).

GUATEMALA

In 1996, the Guatemalan national assembly enacted a new telecommunications law, allowing free entry into all segments of telecommunications and requiring operators to grant competitive interconnection. The state telecommunications monopoly, Guatel was the dominant incumbent and this firm had over 900 frequency rights, as did radio and television broadcasters and the cellular monopolist, ComCel.

In Guatemala, the wireless licencee gains an explicit right to radio frequencies, known as *Titulo de Usufructo de Frequencia (TUF). TUFs* are awarded on request as users petition the state for rights to control unoccupied frequencies. Subsequently, auctions are held when competing claims are made.

The *TUF* is defined by:- (a) frequency; (b) location; (c) hours of operation; (d) maximum power transmitted; (e) maximum power emitted at the border of adjacent frequencies; (f) duration of right (beginning and ending).

In 1996, an independent regulatory body was established, the Superintendent of Telecommunications (SIT). A registry of all uses of the communications spectrum was produced by the SIT. New entrants wishing to access frequencies are allowed to petition the SIT for the right to use any unoccupied bandwidth. The process is as follows: A private party surveys existing spectrum use in the spectrum registry. The party applies to the SIT for the right to unused frequencies. The application is evaluated and a public notice is issued. Parties objecting to the proposed new use can file formal complaints. The grounds for opposition are limited to technical interference. Complaints, if any, are quickly adjudicated via binding arbitration. Other spectrum users are allowed to file competing claims to requested bandwidth rights. If no competing claims are filed, then petitioner receives rights without auction (or payment). If competing claims filed, then the SIT must quickly schedule competitive bidding process to determine ultimate licencee. Lastly the rights extend 15 years and are renewable (without competitive bidding) at the discretion of the user. The rights are freely tradable and regulation is limited to interfering emissions.

Since liberalisation in January 1997 till 1999, SIT has received more than 10,000 requests for spectrum use rights and has conducted 38 spectrum auctions in its two years of existence. The first auction was for 20.8 MHz of nation-wide spectrum in the 800 MHz range, which is used for trunking or specialised mobile radio (SMR). The 20.8 MHz of spectrum were fragmented in pairs of outbound and inbound and also in two types of band pairs, seven of one MHz each and twelve of 200kHz each, The one MHz bands and the 200khz bands were contiguous. Initially there were 11 bidders. The bidders deposited payments that allowed them collectively to bid initially for more than sixty MHz. Seven out of the initial 11 bidders won at least one lot.

USA

The FCC has been keen to develop a secondary market for spectrum and since 1996 it introduced two measures to facilitate the market. Further in November 2000 the Federal Communications Commission[34] (FCC) issued a Policy Statement outlining proposals to promote the efficient use of radio spectrum by encouraging wider development of secondary markets. However the statement recognised that some services such as public safety, educational services, private wireless, amateur radio and other important services may have spectrum needs that are not addressed under a market approach. The FCC's four principles are:

- licensees should have clearly defined usage rights to their spectrum, including frequency bands, service areas, and licence terms of sufficient length, with reasonable renewal expectancy, to encourage investment[35];
- licences and spectrum usage rights should be easily transferable for lease or sale, divisible, or aggregatable;
- licensees/users should have flexibility in determining the services to be provided and the technology used for operation consistent with the other policies and rules governing the service;
- licensees/users have an obligation to protect against and the right to be protected from interference to the extent provided in the FCC's rules.

The FCC's Policy Statement outlines three key areas that it will need to address to achieve its objectives, which are described below.

(i) Eliminate unnecessary regulations and administrative requirements

In particular the FCC plans to consider:

- harmonisation of operating rules for similar services to promote spectrum substitutability;
- modifications to their service definitions, where appropriate, to increase flexibility and maximise spectrum efficiency. Flexibility will allow multiple services to operate in the same spectrum. This would reduce scope for any anti-competitive behaviour;
- identification of circumstances where the FCC will favourably consider waivers from service and technical rules that will increase flexibility and maximise spectrum efficiency.

(ii) Promote the availability of frequency and technically agile equipment

(iii) Promote more effective functioning of market processes

In particular, the FCC plans to consider the following:

[34] www.fcc.gov

[35] In this context, any transferees and lessees will have the same rights to protection against interference and incursions by other operators as the licensee from which they acquire the spectrum..

- maintaining an on-line listing of licences by service, frequencies, and service area, to identify spectrum usage rights to potential buyers/lessees. However, the FCC notes that this would not identify specific spectrum rights to which licensees might be willing to sell or lease;
- supporting development of services that list spectrum resources that licensees are actively offering for sale or lease. The FCC believes that this would be more useful than a simple comprehensive listing of licences by service;
- supporting the establishment of private spectrum exchanges and brokers who would match buyers and sellers of spectrum usage rights. The FCC notes that spectrum brokers could bring specific expertise and knowledge of the unique properties of different spectrum bands to assist prospective buyers.

Comments on FCC's proposals
The FCC received several comments to their policy statement. In particular, a group of 37 economists responded by welcoming the FCC's proposals on spectrum trading but commented that a more free market approach should be taken. The economists made three significant comments.

The FCC should seek not to create secondary markets directly but instead to institute rules allowing such markets to emerge. Buildout requirements on spectrum leases are unnecessary and can burden secondary markets transactions with additional compliance and monitoring costs. If a licensee faces the appropriate opportunity cost of not using spectrum, then there is no need to have a buildout requirement. Further, in the 700MHz Guard band, the FCC has mandated that a carrier must lease out more than half of its spectrum to unaffiliated entities. The 37 economists state that this forces a secondary leasing market to develop.

Relaxing restrictions on the use of radio spectrum by current licensees and new entrants is essential. A broad definition for the types of services that personal communication services licensees can provide, leaves the choice of service provision to those who are best placed to respond to consumer demand. However the economists claim that the FCC should adopt this approach across the board and not on a case-by-case analysis. Wider use of spectrum leasing would increase efficiency and would encourage entry.

The FCC should eliminate all wireless licence requirements unrelated to interference or competition issues, namely eligibility, service, technology and implementation requirements. For instance:
- Eligibility requirements restrict licence assignments to specific categories of potential licenses. These can impose costs on consumers by giving priority to relatively inefficient suppliers;
- Specifying the use of spectrum can prevent it from being used to deliver services that consumers' demand.

Rules limiting interference provide good information on where one operator's rights stop and another's begin. As long as new technology respects existing interference boundaries, it should be allowed.

Build out requirements force licensees to introduce a service by a fixed date. A firm may wish to acquire more spectrum before rollout or it may want to wait for the next generation of capital equipment. It may be efficient to allow users to incur the opportunity costs of build out delays.

The economists recommended that these changes would increase flexibility and reduce uncertainty in the secondary market. The flexibility could lead to windfall gains to incumbents of holders of spectrum, but would simultaneously reduce licence values by introducing competition. The economists highlighted that efforts to extract gains from licensees or compensate for losses should not be permitted unduly to hinder or delay the benefits of promoting competition through spectrum liberalisation.

CANADA

To date there has been limited spectrum trading in Canada. The Government allows some spectrum licenses to be transferred between firms providing the same service.

Recently Industry Canada held an auction for additional Personal Communication Services (PCS) in the 2GHz Frequency Range. One of the features of the auction was that the licences were transferable and divisible in a secondary market. The licences were transferable in parts of the spectrum and/or bandwidth dimensions, subject to certain conditions and guidelines.

The Canadian Government aimed to provide maximum flexibility to the licensees to accommodate their future business plans. However during the public consultation process some concerns were expressed regarding the divisibility of spectrum. Some respondents were concerned that spectrum blocks, less than 10MHz could create a number of co-ordination and technical issues, which may make it difficult to implement 3G PCS services.

Table A1: Summary of spectrum trading experiences in non-CEPT countries

Country	Implementation	Nature of Rights	Interference Issue	Competition Policy	Public Information	Volume of Trades
Australia	Auction held in 1997 in the 500 MHz band. The band was chosen because it was largely unencumbered in Australia's populated areas and so it offered a fairly low risk (albeit low value) area to test. The auction was a simultaneous ascending auction. Spectrum licences sold by auction then fully tradable.	Spectrum access rights defined in terms of geography and frequency. Rights are in the form of standard trading units, which are like building blocks. Apparatus licences traded under these provisions still retain the original licence conditions (e.g. type of service, site, transmitter power etc) unless the ACA agrees to change the conditions of the licence. Apparatus licences tend not to be auctioned, although if a channel is surrendered, the ACA may re-issue the channel via an auction. Licences are for a fixed term of up to 15 years. Apparatus licences have a maximum period of five years (more commonly annual) but can be 'renewable'.	There are limits on emissions at the boundary of a licence in order to manage interference with a licensee's neighbour. Maximum power levels set for out of band interference.	Spectrum is treated like an asset. The Aust. Competition Authority deals with any competition issues regarding the acquisition of spectrum.	On-line register of spectrum licenses is available but information on confidential users of spectrum is not available. The register allows buyers of spectrum to search for sellers but not vice versa. Pricing information is not collected nor recorded on the database. The ACA plans to improve the database over time.	Fewer than 100 spectrum licences traded in the last year. The majority of these trades were whole licences. Around 2000 apparatus licence trades, mainly in private business radio.
New Zealand	Introduced in 1989, applied first in broadcasting where the perceived need for reform was greatest.	A management right over any defined frequency band, nationwide, and for a specified period (but limited to a maximum term of 20 years by the Act) A licence right by the owner (manager) of a management right for frequencies within the frequency band of the management right.	Management rights are protected by adjacent frequency emission limits that define the strength of out-of-band emissions. Management rights holders are not responsible for ensuring their license rights holders comply with the interference limits. Licence rights are legally enforceable and conciliation and arbitration processes are being established to resolve disputes. If these fail, the courts provide a last resort.	General Competition law applies to spectrum trading. The Commerce Act is currently under amendment	Public register of spectrum rights consists of government and civil spectrum use. Some assignments are excluded. Currently working towards making data available to the public through the Internet.	Generally low volume of trading overall. However the greatest volume of trades were in spectrum licences within AM and FM sound broadcasting.

Table A1: Summary of spectrum trading experiences in non-CEPT countries (continius)

Country	Implementation	Nature of Rights	Interference Issue	Competition Policy	Public Information	Volume of Trades
USA	Since 1996, FCC has been introducing measures to encourage secondary markets. These measures have promoted the partitioning /disaggregation of licences and the leasing and resale of spectrum.	Licences can be transferred but must be notified to the FCC for approval. Spectrum leasing allows temporary partitioning, disaggregation, or partial assignment of a licensee's spectrum usage rights, without the complete and permanent transfer of control.	Interference issues are dealt with by FCC	Spectrum caps and competition law, although caps are being phased out.	Wireless licensing data available on-line, including maps showing licensing areas and service providers. Information is available mainly via private sector. For example, Comsearch has developed a commercial spectrum database: www.comsearch.com.	1000s of transfers a year.
Guatemala	In 1996 auction for 20.8 MHz of nationwide spectrum in the 800 MHz range which is used for trunking or specialised mobile radio.	Licensees gain an explicit right to radio frequencies. The rights are awarded on request and auctions are used when competing claims are made. The rights are freely tradable.	With each right there is a maximum power emitted at the border of adjacent frequencies.	Unknown	Computerised database is available which consists of registry of all spectrum uses.	Over 3400 new rights were awarded under the spectrum reforms as of March.
Canada	To date there has been little trading. Auction for PCS in 2GHz Frequency Range allows licences to be transferred and divisible in a secondary market.	All conditions that apply to a licence will continue, as applicable. Licences will be divisible in the geographic dimension, only in terms of spectrum grid cells. There is no minimum limit to divisibility in the band width dimension. Buyer must meet the eligibility criteria. Buyer of the licensee will receive a licence term equal to that remaining on the original licence but will be eligible for the same license renewal provisions as the original licensee. Incumbent licences are not subject to this more liberalised transferability regime, although this is under consideration.	Unknown	Any license transfer may be subject to the Competition Act.	The Government plans to maintain a publicly accessible database that lists all auctioned licences and the respective licensees and will be updated upon a licence transfer.	Small.

ANNEX V: LEGAL CONSIDERATIONS AROUND COMPENSATORY PAYMENTS

This Annex contains a legal analysis of compensatory, which should be considered as one of the possibilities of interpreting the concepts of state-aid and subsidies..

1. Introduction

In general any kind of payment made by the State necessitates an *immediate* legal – or at least jurisprudentially – base. Exceptionally, it could be considered that a *mediate* legal base (for example a provision in a law which lays down the objectives of the administration) is sufficient in the case of a payment to an individual by the administration when this payment is resulting from an obligation contained in a contract of administrative law.
But the principle of legality applies to both the legal base and the activity of the administration resulting from a contract of administrative law. Accordingly the legal base and the activity will have to be compatible with *inter alia* the constitutional principles. Further both must be interpreted in the light of these constitutional principles. Indeed, in a Constitution "choices" are made which are binding the legislature - and even more the administration executing the legislation.

The principle of legality is constituted of the combination of two principles: *the principle of supremacy of the law* and *the principle of the legal base*. The principle of supremacy of the law affirms the prevalence of law: the whole administration has to respect the totality of legal norms. The principle of the legal base is influenced by this principle as it affirms, in the first place, that the absence of legal norms means the absence of administration – there are no competencies of the State besides the ones laid down by the law. In the second place, the principle of the legal base introduces a distinction among legal norms, as only those which have the quality of a statute, i.e. which have been adopted by a legal body according to a formal procedure, are qualified in order to found an act of authority. Accordingly, if a payment has to be made by the administration to an individual, this has *in theory* to be expressly mentioned in the provision of a formal law.

- **In the *presence* of an express legal base for a payment:** In the States were a provision exists in a statute which enables the spectrum management authority to pay the incumbent spectrum user in order for the latter to vacate this band, this document may be superfluous. However, the scope of such a provision is limited to cases where the conditions for a compensation of the incumbent are fulfilled. Indeed this restrictive interpretation is necessary in order to ensure the constitutionality of the provision (or for those States concerned the conformity with EU law, in particular the provisions in the EU Treaty on State aid [Article 87 EU Treaty]).
Among many constitutional principles which have to be considered is the principle of *equality of treatment* - of which a consequence is the prohibition to distort trade. Another important constitutional principle is the *economical freedom of individuals*, i.e. the State should not intervene in the economy and business world.
If the payment made by the spectrum management authority in order for the incumbent spectrum user to vacate this band has the features of an incentive grant, then these principles are infringed. From a general point of view in order for the action of the administration to be neutral regarding competition if incentive grants are paid they should be paid to *all* spectrum users who are supposed to vacate the assigned frequencies – or to none. However, if the incumbent spectrum user and other spectrum users are active on the same market, a payment from the State to the incumbent having the nature of an incentive grant will certainly distort competition. Many of the considerations made in Chapter 8.2 below can be helpful to clarify further this point.
- **In the *absence* of an express legal base for a payment:** It is specifically for States where this is the case in the legal provisions for spectrum management that this chapter has been written. Should the spectrum management authority pay the incumbent spectrum user in order for the latter to vacate this band, this payment could only occur on the basis of the general provisions or legal principles of administrative law applying to cases of compensation. Compensation payments will be based on the general principles of administrative law concerning the liability of the administration when it repeals or modifies a decision or abrogates or modifies a normative act.
With regard to incentive grant payments the only foundation would be contracts of administrative law concluded between the administration and the incumbent spectrum user. But, first, the legal base for the conclusion by the administration of such a contract is not obvious. Second, should the spectrum management authority nevertheless have the possibility to conclude such contracts of administrative law, the fact remains that payments to be made by the spectrum management authority to incumbent spectrum users which have the features of incentive grant breach the interdiction (*material*) to grant State aid [Article 87 EC Treaty]

2. Compensation

A compensation has to be understood in the sense of a payment due in order to repair an *illicit* damage caused to a third party in a faulty way.

The compensation of the State to a third party discussed in the present Chapter should be the object of a law. However, this is not always the case. In absence of a law, the jurisprudence should have set up these principles.

In any case, compensation is founded on the breach of the confidence[36] the third party put in the coherent behaviour of the administration. Such a case can occur either when a decision[37] is repealed or modified or, more exceptionally and under different conditions, when a normative act[38] is abrogated or modified.

Out of the constitutional principle which obliges the administration to be of good faith (which is a constitutional right of individuals[39]) flows the principle of protection of confidence. Individuals can claim in front of a court to be protected by law when in a legitimate way they trusted assurances or acts from authorities and on the base of these expectations the individuals have made investments which are nullified due to the subsequent reverse of position by the authorities. The protection of the law leads to a compensation (granting of damages) provided to the individuals if the responsibility of the administration is recognised. This principle should prevent individuals from suffering from a detriment when they have trusted the coherent conduct of the administration.

Compensation when a **decision** *is repealed*

In general

The decision is a unilateral legal act of the administration in application of a law or decree which has consequences on the legal situation of the individual it is addressed to. Being unilateral, the decision can also unilaterally be repealed or modified by the administration which took it. This should especially be the case when the decision is infringing material law and accordingly needs to be repealed or modified in order for the situation to be again in conformity with the law. It must however be noted that revocation or modification of a decision, even if the latter is unlawful, shall be an *ultima ratio*.

The principle of security of the legal situation[40], which implies that in the interest of its addressee the decision has to be maintained, should prevail on the principle of legality, which on its side would imply the return to a situation in conformity with the law, unless there is a strong public interest in favour of revocation or modification of the decision. When there is no illegal situation, it is almost impossible to repeal or modify a decision, as the balance of interest will inevitably be in favour of the addressee (and "beneficiary") of the decision - unless there is a primordial public interest to do the opposite. According to circumstances, in such a case where the balance of interests is in favour of revocation or modification, the addressee of the decision must nevertheless be indemnified. However, indemnification takes place only if a set of cumulative qualified conditions are fulfilled. These are:

1. the presence of an act of the administration which is suitable for an individual to derive confidence from it (a decision addressed to a third party is generally considered as such an act in which the latter can trust), for example the authority must have been competent or did not have informed of restrictions[41];
2. the addressee must be of good faith, i.e. he must actually not have recognised or not have been in a situation enabling him to recognise that his expectations flowing from an act of the administration cannot be realised, in particular because this act is illegal[42];
3. the addressee must have actualised his expectations by having made arrangements which cannot be reverted without detriment or inconvenience for him, like for example having made investments[43];
4. since the act of the administration, there must not have been major modifications in the factual or legal environment[44] [45]; and
5. exceptionally, the weight of the public interests in favour of a revocation or modification can even exclude the compensation of the third party[46].

In the field of frequency management

Examples of revocation or modification of a decision in the field of frequency management are: the modification of the assigned frequency, the annulment of a radio licence, or the modification of the (technical and/or regulatory) conditions attached to the radio licence.

---

[36] In German: „*Verletzung des Vertrauensschutzes*".
[37] Characterised in French as: „*acte juridique individuel et concret*".
[38] Characterised in French as: „*acte juridique général et abstrait*".
[39] In German: „*verfassungsmässiges Individualrecht*".
[40] In German: „*Wahrung der Rechtssicherheit*".
[41] Summarised in German with the notion of "*Vertrauensgrundlage*".
[42] Summarised in German with the notion of "*Vertrauen in das Verhalten der staatlichen Behörden*".
[43] Summarised in German with the notion of "*Vertrauensbetägigung*".
[44] Summarised in German with the notion of "*Keine Änderung des Sachverhalts oder der Rechtslage*".
[45] In either case the outcome of the application of an eventually new legal provision to an eventually new factual situation by the administration in a unilateral legal act would not be the same anymore which excludes the creation of a state of legitimate expectation to which individuals could appeal.
[46] Summarised in German with the notion of "*Abwägung zwichen dem Interesse am Vetrauensschutz und den entgegenstehenden öffentlichen Interessen*".

However, as has been mentioned before not all imaginable examples of revocation or modification are cases where the licensee could benefit from a compensation. For example costs occurring to a radio licensee in case of a modification of the assigned frequency before the expiry of the radio licence due to major technical and costly interventions on the licensee's equipment do for sure deserve to be compensated. The loss of a legitimate future benefit occurring to a radio licensee having benefited from a radio license which was issued on the basis of yearly renewal but has been revoked with a very short notice by the licensing authority and the residual value of the equipment as the radio licence was revoked before the equipment which the licensee acquired in good faith could be written off have to be compensated.

There will always be a sufficiently strong public interest in favour of revocation or modification of a radio licence as the public interest is the efficient management of the public and scarce resource radio spectrum. A payment to an incumbent frequency user whose radio licence is revoked or modified by the frequency management authority can with certainty be made (i.e. it is in conformity with the law) – whether by means of a refarming fund or other - when the stringent conditions for this payment to be qualified as a compensation are fulfilled.
If these conditions are not fulfilled the payment made cannot be qualified as a compensation. The payment in such a case can only be qualified as *incentive grant* (see below).

Compensation when a **normative act** *is modified*

In general
"*Nul n'a le droit au maintien de la loi.*" This principle implies that it is always licit for the State to modify normative acts. However, a principle developed by the jurisprudence nevertheless envisages the possibility to compensate persons, which are especially affected by the modification of a normative act by the State[47]. This is due to the fact that this action by the State induces a qualified inequality of treatment of very few individuals as compared to the public in general.
However indemnification takes place only if a set of cumulative qualified conditions are fulfilled. These are:

1. Only one or a few persons suffer a prejudice[48];
2. the detriment must be important in such a way as to create an obvious disproportion with the effects of the measure on other persons[49]; and
3. the measure is not a normal and usual activity of the State[50].

In the field of frequency management
Examples of abrogation or modification of a normative act in the field of frequency management are: the modification of frequency allocation, the modification of civil – non-civil allocation of spectrum, the modification of the conditions of use, or the modification in the law of the conditions for the issuing of radio licences.
Standards of radio applications and spectral characteristics for the usage of the air interface which are laid down by the spectrum management authority in order to ensure the efficient use of radio spectrum are norms which are usually not referenced directly in the radio licence.
A particularity is that these modifications of a frequency allocation will imply a modification of the frequency assignments, radio licences. But the rules applying to the compensation in case of revocation or modification of an individual and concrete administrative act will not be applicable (see fourth of the necessary legal conditions above). Payment will solely be made to the holders of revoked or modified individual frequency assignments if the conditions for compensation in case of abrogation or modification of a normative act are fulfilled. Indeed the administration by revoking or modifying the decisions does not deceive legitimate expectations of the radio licensees.
On the other hand, in the field of frequency management there are areas where general and abstract acts (norms) do not find any fulfilment in form of individual and concrete acts (decisions). The modification of these general and abstract acts may nevertheless cause a damage to individuals (spectrum users). This case could especially occur in frequencies which are not assigned individually, i.e. where a general authorisation is granted in a norm.

Clearly it is most important for the competent authority to foresee long enough transitional periods before the entry in force of the modified norms.

As has been mentioned before not all imaginable examples of abrogation or modification of a normative act are cases where radio spectrum users could benefit from a compensation.
The State – and the spectrum management authority – will always have the faculty to modify general and abstract acts in the field of spectrum management, in particular frequency allocations. A payment to frequency users affected by, for example, a modification of a frequency allocation by the frequency management authority can with certainty be made (i.e.

[47] In German the principle of „*Sonderopfer*".
[48] In French: "*seules une ou quelques personnes subissent un préjudice*".
[49] In French: „*le préjudice doit être élevé de manière à créer une disproportion manifeste avec les effets de la mesure sur d'autres administrés*".
[50] In French: „*il ne doit pas s'agir d'une activité publique normale et courante*".

it is in conformity with the law) – whether by mean of a refarming fund or other - when the stringent conditions for this payment to be qualified as a compensation are fulfilled.
If these conditions are not fulfilled the payment made cannot be qualified as a compensation. The payment in such a case can only be qualified as *incentive grant*.

3. Incentive grant

An incentive grant has to be understood as a payment made with the aim of inciting a third party to have a certain conduct which lies in one's own interest.
In the context of spectrum refarming it has to be understood as a payment made in order to avoid constraining measures directed against the incumbent spectrum user, in order to avoid an uncooperative attitude when he is supposed to vacate the band. Indeed, the spectrum belongs to the State and constitutes part of the public domain. The attribution of a licence does not confer ownership of frequencies but only the right to use them during a certain period[51]. Accordingly, the licensee is obliged to vacate the spectrum once the licence has expired. Thus, when stating that the incumbent spectrum user "is supposed to" leave the spectrum, it is an understatement. The following considerations are central for the opinion to refuse payment of incentive grants to incumbent spectrum users:

- Spectrum is a public good the management of which has been transferred to the State.
- There are no property right of individuals on it. There are neither "*droits acquis*" on it (i.e. rights which are immune regarding modifications of the law during the period for which they have been granted).
- Every and any spectrum user needs an individual authorisation to use the public good (exception: general authorisation) and the validity of the radio licence has to be limited in time. If the spectrum user is not in possession of a valid radio licence, he has no right to use the spectrum, further the use of spectrum in such a case is even illegal and subject to penalties.

The payment of incentive grants is thus before all a political choice. Though, the constitutionality, respectively legality, of an express legal base for such payments seems very dubious – apart in very exceptional cases (when the State aid is eligible for a derogation according to EU law). In case of absence of an express legal base in order to make a payment having the characteristics of an incentive grant, the only possibility in order for the spectrum management authority to make such a payment remains the institute of the contract of administrative law.

4. Contract of administrative law

The legal institute of the contract of administrative law is a bilateral act – between the administration and co-contractants – like its equivalent of private law, but it is submitted to public law.

In general
The contract of administrative law is an institute halfway between the decision and the contract of private law as, from the material point of view, the parties to the contract – and in particular the administration – are bound by provisions of public law which limit their contractual freedom and, from the formal point of view, there are no specific procedural rules which must be followed before concluding such a contract. One such contract is the *collaboration contract* where the determinant service/activity is done by the co-contractant (private party) and this activity is serving directly the realisation of a public interest. One could consider that a contract by which the frequency management authority makes an agreement with an incumbent spectrum user for the latter to leave a frequency range against the payment of an amount of money could be such a contract.
But there are legal conditions to be fulfilled in order for the administration to have the capacity to use the form of the contract of administrative law in order to reach one/some of its aim(s) of public interest. First of all, there is a necessity to examine whether the law authorises the obligations as flowing from the contract of administrative law and burdening the co-contracting individuals, considering that these obligations are not founded on the law but on a accord of intent.

Accordingly, if the law organises a system of allowances and obligations generally applicable in order to ensure equality of treatment, it is obvious that a contract - which by definition would create inequality – is excluded. Concluding a contract of administrative law is only possible for the administration insofar as it is authorised by the law (or insofar as nothing in the law forbids it to the administration) to individualise its service to an individual in function with the latter's counter-service, which the administration is not in a position to require unilaterally. However, the principle of supremacy of the law remains applicable, which implies that the authority cannot circumvent the law by making a contract with an individual, if in comparison to the law the administration exceeds its competencies conferred – respectively limited – by the said law with regard to the obligations the administration can impose on the contractual partner (i.e. the law has as an objective to prevent the administration from limiting so extensively the freedom of the individual).

[51] See ITU Document 1B/28-E which is a contribution by France dated 29 October 2001 entitled „Refarming: a Dynamic and Flexible Method of Spectrum Management", Chapter 1.2, p.4. See also ITU Document 1B/26-E which is a contribution by France dated 29 October 2001 entitled „Guidance on the Regulatory Framework for National Spectrum Management", Chapter 2.1.1.2, p.15.

With regard to the faculty of an administration to conclude a contract of administrative law the scope of the principle of a legal base for this action of the administration cannot be understood as strictly as it is the case for decisions[52]. However, a dependence of the administration from the law is necessary. Accordingly, (1) *the public task materialised by the contract must have been acquiesced by the legislature*, i.e. the central charge of the contract – be it the one of the administration or of the co-contractor – must be motivated by a public interest whose promotion is proclaimed by the law as a public attribution, and (2) *the legal sphere recognised by law to individuals has to be protected*, i.e. the agreement must be justified by pertinent reasons of public interest, the exchanged services must objectively be proportionate, the administration must not have used means of pressure unforeseen or forbidden by the legal order.

In these States where use must be made of the institute of the contract of administrative law (e.g. in absence of an explicit legal base), it *could* nevertheless be reckoned that the mission given in a legal provision to the spectrum management authority to manage efficiently the spectrum is a sufficient legal base in order for this authority to conclude a contract of administrative law with an incumbent spectrum user. It could in particular be reckoned that following the conclusion of such a contract a payment would be made to the latter in order to induce him to vacate the frequencies he is occupying. It is agreed that in such a case the spectrum management authority would be handling for the public interest, i.e. the efficient management of the public and scarce resource radio spectrum, which could confer a *mediate* legal base to the conclusion of such a contract by the administration. In my opinion however such an aim of public interest is in principle insufficiently precise according to the principle of the legal base in order to establish a faculty for the spectrum management authority to directly make any kind of payments to spectrum users. It is accordingly insufficient in order to give the faculty to the authority to conclude contracts of administrative law having as an objective to induce the incumbent out if the frequency band against payment. But as this point of view can be subject to – legal – debate, I will nevertheless address the contrary assumption. In my opinion from a general point of view a provision stating the mission of a public authority may essentially help to interpret extensively specific *existing* competencies of an authority – but not create new competencies.

In the field of frequency management

As stated in the introductory paragraphs to Chapter 9.3, with regard to radio spectrum the administration is in a position to require unilaterally (even with the possibility to threat with a criminal proceeding) that an incumbent spectrum user whose radio licence has expired to vacate the occupied band. Thus it is hardly justifiable why a contract of administrative law should be concluded with the incumbent spectrum user when a simple decision would reach the same result - moreover with almost no cost for the taxpayer.

Consider nevertheless that a contract of administrative law can be concluded. Generally, a law stipulates that it is the competence of the State to manage the spectrum. Moreover, the law gives as an objective to the spectrum management authority to manage efficiently the public and scarce resource radio spectrum. This base would then be presumed sufficient for this authority to conclude contracts with incumbent spectrum users in order for these to leave the frequency bands they are presently occupying against payment.

Insofar it is considered that it is compatible with the legal order for the spectrum management authority to conclude a contract of administrative law having such a content with the incumbent spectrum user, however the hurdle of EC competition rules (interdiction of State aid) remains to be passed.

5. State aid

A State aid is defined as an aid granted by a State or through State resources in any form whatsoever *which distorts or threatens to distort competition* by favouring certain undertakings or the production of certain goods (Art. 87(1) EC Treaty [ex-Art. 92(1)]).

In general

Substance and not form is the guide for the definition of a State aid. Accordingly the effect or aim of the payment has principally to be considered: are certain undertakings or the production of certain goods favoured? With other words: is the payment placing the recipient in a more advantageous position than it would have been in without this financial benefit?

In order to determine whether the measures are in the nature of State aid following complementary criteria can be used:

1. whether the undertaking could have obtained the amounts in question on the capital market (i.e. from the private sector); and
2. when capital is invested/money paid by a public investor there must be some interest in profitability in the long term for the public investor.

[52] If the faculty of the administration to intervene in the legal sphere of individuals would expressly be established in law, there would be no need for a contract as the administration could impose unilaterally its will on the other party.

General measures of economic policy will not in themselves be classified as aid. It is also clear that a measure will be classified as aid even if it benefits a whole range of undertakings. The dividing line between general measures of economic policy and State aid may be a fine one.
Of course the interdiction of state aid is not absolute. The possibility to derogate to the interdiction exists. Derogations according to (Art. 87(3) EC Treaty [ex-Art. 92(3)]) are only possible if the Commission can establish that the aid will contribute to the attainment of one of the objectives specified in the derogations, which under normal market conditions the recipient firms would not attain by their own actions. These objectives are: (1) promotion of the economic development of certain areas, (2) promotion of the execution of important projects of common European interest, (3) promotion of the development of certain economic activities, (4) promotion of culture and heritage conservation, and (5) aid specified by decision of the Council.

The incentive grants in environmental matters should be considered as a model as they have been reckoned to be compatible with the rules on State aid when certain stringent conditions are fulfilled. The EC Commission published "Community guidelines on State aid for environmental protection"[53].

In the field of frequency management
The policy of the spectrum management authority to induce incumbent radio spectrum users whose radio licence have expired cannot be considered as a general measure of economic policy.

It is a certainty that in most cases such a payment to the incumbent spectrum user will distort or threatens to distort competition, and will accordingly be qualified as an aid.

The fact to induce all incumbent spectrum users cannot be considered as a sectoral aid (i.e. treating more or less equally all competitors in a sector) as the sector in cause cannot be limited to the incumbent spectrum users but to all present and future/potential spectrum user.

The worst case would be the payment of an incentive grant to the incumbent user in a frequency band which will be auctioned in a latter stadium, and the incumbent would take part in this auction. He would clearly have a competitive advantage on the other participants as his financial means would include the payment made by the State in addition to the financial means he has gathered on the financial markets or in his own finances. Even if the frequencies are not used in order to offer a telecommunication service, why should the remaining frequency users receive an incentive grant in order for them to leave, whereas those who already left on their own initiative will not get anything?

Even the payments by the spectrum management authority of incentive grants to the clients of the incumbent spectrum user, for example in order for them to buy radiocommunication equipment working with a different technology and/or in a different frequency band, are qualifiable as aid.

Moreover, there is no possible derogation for such an aid apart when the objectives of the administration would not be attained by the own actions of the recipient firms under normal market conditions. If the incumbent has no right to keep using the public resource radio spectrum anymore as his licence has terminated, why should he get any money? In my eyes it is very difficult to get a derogation in these conditions, as the objective of having the incumbent user leaving the frequency band can be attained with other (legal) actions than payment of incentive grants.

6. Legality of the payment to the incumbent spectrum user by the newcomer

Nowadays it became an obligation for spectrum management authorities to make private parties bear as much costs as possible. This lead to the idea that in case of refarming the newcoming spectrum users could be burdened with the costs of the refarming procedure. Below the point of view is developed that this is only possible to a very limited extend.

Compensation

The question is whether the costs arising from the liability of the administration (compensation) can either be added to the initial radio licence fees or be included in (cost-based) administrative fees which will be burdened on the newcoming spectrum user? The other way round the question would be to know who has to pay the costs occurring to the State due to the compensation of an incumbent spectrum user: an individual/a group of individuals, the taxpayer, or both partly?

The Swiss perspective: The Swiss dual system including both a cost-covering fee-setting system and a fee-setting system based on non-financial criteria allows to answer the question. In order to give an answer *the nature of the costs occurring to the State have to be differentiated*. Indeed, on the one hand the *administrative fee* levied when issuing a radio licence covers the costs occurring to the administration due to its efforts when the latter acts on request of or due to the conduct of an

[53] Official Journal No C 73, 10.03.1994, pp.3-9. These Guidelines are however no longer in force.

individual. On the other hand the *radio spectrum fee* is a return to the State by individuals who have been granted the right either to perform an activity actually reserved to the State or to use a common property on a more extensive basis. Its scope is solely defined by economic thoughts and should reflect the economic value of the regalian right which is leased to the user. This fee is cost-independent.[54]

Two kind of expenditures by the administration in the case of a compensation must be distinguished: First, the costs occurring because of the efforts of the administration to evaluate and than compensate the damage (including the eventual work in connection with legal challenges of the height of the damages provided). Second, the compensation itself which is an amount of money destined to cover an economic/financial damage suffered by an individual.

The costs occurring because of the efforts, "work" of the administration can be included in the administrative fee the new spectrum user will have to pay by issuance of the radio licence in the frequency band abandoned by the incumbent spectrum user and beneficiary of a compensation. On the other hand the compensation itself (damages) cannot be included in the administrative fee[55] but will indirectly – and hopefully - be covered by the radio spectrum fees the new spectrum user will pay. The radio spectrum fees are paid to the general budget of the State – budget which previously financed the compensation given. Accordingly, it can be hoped that the payment of the radio licence fees will balance out the compensation – though this should in no way be an aim of the spectrum fee. The latter's primary objective remains to achieve an efficient usage of the spectrum by mean of the implementation of spectrum pricing.

In conclusion, the State cannot require from the newcomer in a frequency band to pay to the incumbent a compensation paid by the State. The reason for the payment of the compensation to an individual would be in the present situation a mistake by the administration. On base of legal/judicial principles the administration is liable towards a private party as it committed an error which affected the their financial wealth. The obligation made to another private party to bear immediately the costs of an mistake committed by the administration would be illegal.

Incentive grant

Should despite all the arguments given against them in the previous Chapter nevertheless incentive grant payments being made, a second contract of administrative law would be necessary if the frequency management authority would wish the newcomer in the vacated frequency band to pay back the incentive grant payment made by the State to the incumbent. Such an administrative contract would be infringing the legal sphere recognised by law to individuals (not having to pay any dues to the State without a sound legal base – i.e. formally accepted by Parliament – sustaining such payments) and would thus be *illegal*.
Exactly the same reasoning applies here as under Chapter 9.4.1 should such a contract nevertheless be considered legal. Only costs occurring because of an activity/work/effort of the administration can be burdened on the new spectrum user. These costs will be considered when setting the administrative fee.

Not to be confused with spectrum trading

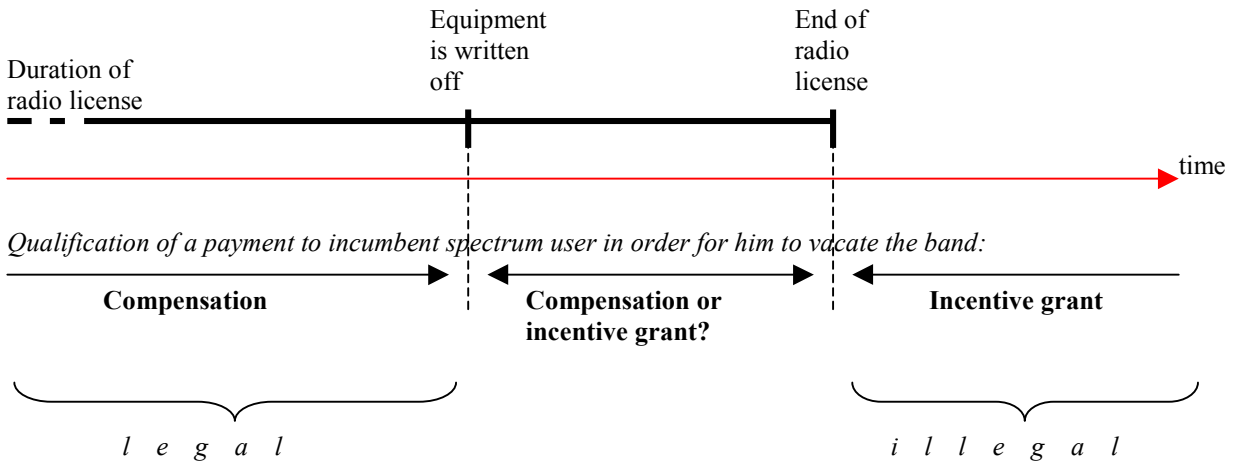
Spectrum trading is first of all based on a contract concluded between two private parties. In most countries the particularity of this contract is that for the latter to enter into force that the contract is approved by the licensing/spectrum management authority.
In this contract – like in many contracts between private parties – incumbent engages to a certain action (transfer of the radio licence) against the payment of an amount of money by the newcomer. Both parties are acting according to their free will within the limits of what is authorised by law.

Negative legal implications for a payment not to be qualified as compensation

Though not having the pretension to be exhaustive but having considered the numerous uncertainties – mainly on the legal level – the following conclusion is drawn:
The legality of a payment to an incumbent spectrum user with regard to the rules on State aid is primarily dependent on its qualification of compensation or incentive grant. If the payment is qualified an incentive grant – i.e. it is not qualified a compensation – then it is highly likely to be infringing competition rules on State aid. The qualification of a payment is essentially dependent of the moment when payment is made as compared to the moment of cessation of validity of the radio licence. Moreover, the conditions for a compensation must be realised, and in particular there must be a financial detriment or inconvenience for the incumbent spectrum user because of the vacation of the band.

[54] For more details on the Swiss fee-setting system see ERC Report 105 "Review of PMR Fees", The Hague, February 2001 and draft ERC Report 108 "Review of Satellite Fees", not yet adopted.
[55] If only because of the *principle of proportionality* applying to administrative fees.

Schematically:



For a payment not to be qualified of compensation means that it exposed to a high legal incertitude.

Payment of compensations

In case of refarming of frequencies the spectrum management authorities has to limit its payments to incumbent spectrum users to compensation payments in order to avoid getting involved in an area (payment of incentive grants) where the legal situation is very unclear and where – worse – essential constitutional principles (among many: equality of treatment) and provisions of EU law (competition rules on State aid) are very likely to be infringed.

Either the law on compensation (if available) or the well-established general jurisprudence in matters of compensation because of cancellation or modification of a decision or, more exceptionally, because of the abrogation or modification of a normative act will ensure the necessary stability in the practice of the spectrum management authority for compensation payments.

Only the costs occurring because of the efforts, "work" of the administration can be included in the administrative fee the new spectrum user will have to pay when the radio licence is issued to him in the frequency band abandoned by the incumbent spectrum user and beneficiary of a compensation. To the opposite the compensation itself (damages) cannot be included in the administrative fee. However, the fact that a band is liberated rapidly is raising the price of the spectrum fee for the radio licences (spectrum pricing). Over the years the amount paid as a spectrum fee by the newcomer may then finally cover the compensation paid by the administration to the incumbent spectrum user.

ANNEX VI : APPLYING SPECTRUM TRADING TO BWA[56]

I. CURRENT BWA STATUS IN EUROPE

BWA Service Concept

There are many known solutions for local radio access [1, 2], known as Broadband Wireless Access (BWA), also as WLL (Wireless Local Loop), FWA (Fixed Wireless Access) or MWS (Multimedia Wireless System), but they all share the basic service concept, as shown in Fig. 1.

Essentially it is the provision of an integrated set of telecommunication services by direct connection of the end users at fixed locations to the core network over the radio interface. It is only the size of that set of services, data throughput and radio interface technology, which differentiates many systems of radio access. Through the rest of this article we try to keep a technology neutral approach and refer to all such systems generally as BWA, except where it is necessary to highlight certain technology impact on the subject of our discussion.

But what has to be noted here is that already by their definition, the BWA networks realise technical convergence of distinctive telecommunication services (traditional telephony, data/IP, and broadcasting) into a single service offering to the end user. This is very important for the eventual licensing regime for BWA networks, as it leads to the conclusion of irrationality to prescribe particular telecommunication services to be authorised by a BWA licence. Instead BWA licences could just infer the right to provide transparent radio connectivity between the fixed set of subscribers and the under lying telecommunication network, by using a given frequency band. Amongst other items that BWA licences do prescribe today, is the addressable market (e.g. residential access only), networking technology and standards, coverage requirements, etc.

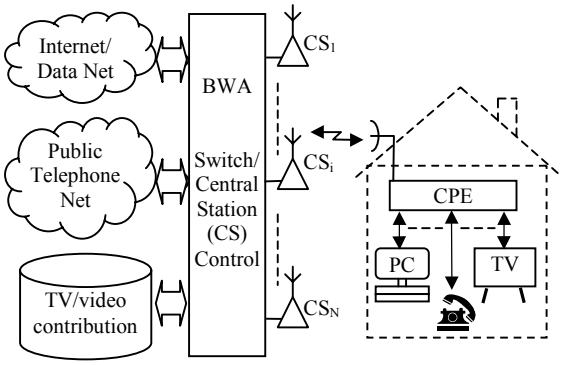


Figure 1: Basic service concept of BWA (CPE – Customer Premises Equipment)

BWA Frequency Allocations

A number of frequency bands have been allocated in Europe for BWA, as shown in Table 1. It may be seen that even if not all bands listed in Table 1 are made available for BWA deployment in a given country, still the number of licensed networks may be sufficiently high by using only one or two bands.

TABLE I
FREQUENCY BANDS ALLOCATED IN EUROPE FOR BWA

Band	Typical link length, km	Typical bitrate, Mb/s	Supportable networks
3400-3600 MHz	10-20	<2	2-3
10.0-10.68 GHz	<10	2-28	2-3
24.5-26.5 GHz	<5	<34	3-5[a]
27.5-29.5 GHz	<5	<34	3-5[a]
40.5-43.5 GHz	1-3	34 and above	3-5[a]

[a] Number considered sufficient to ensure competition, technically even higher number of co-located networks might be supported

The variety of the bands allocated for BWA allows making various preferences in terms of balancing network coverage, service speeds and necessary financial investments. However, the most promising bands for the long-term BWA deployment are the so-called "millimetre" (mm) bands at 26, 28 and 42 GHz, as they provide sufficient capacity for truly broadband services and allow many co-located networks. And while the band 40.5-43.5 GHz today remains practically unused because of still prohibitively high technology costs, the other two bands are used increasingly across Europe [3].

Some other bands than those shown in Table 1 are used for BWA in a few European countries, where not all or not the whole of the bands shown are available, or for various other reasons. However, such variations are few and normally limited to a particular country.

Licensing Pattern

The number of issued or planned BWA licences vary across different countries, but the main pattern seen throughout Europe is to allow at least two-three nation-wide BWA networks and a few regional networks in each given locality.

It is also often observed that the nation-wide BWA operators are given a choice of having two frequency bands – one in the lower part of the spectrum (e.g. 3.5 GHz, 10 GHz) and one in the higher (e.g. 26 GHz, 29 GHz). This choice of frequency band allows better dimensioning of the nation-wide networks, with lower frequencies used in scarcely populated rural areas and higher frequencies in dense urban areas.

State of BWA Deployment

[56] Material in this annex is based on an article published at IEEE IEMC-2002, 18-20 August, Cambridge (UK)

A recent study for the European Commission [4] showed that after a few years of development the BWA still remains an effectively niche technology, not comparable with the penetration of ADSL and Cable, which up to now appear to dominate the residential broadband market in Europe. At the same time, a new CEPT/ECC study [3] showed clear activities on BWA licensing and on the operating side, as the cumulative number of licences and frequency assignments for BWA type networks in 21 European countries increased almost ten-fold over the last four years, see Fig. 2.

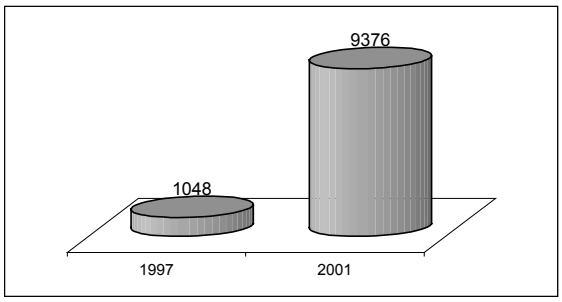


Figure 2: Cumulative number of BWA BS frequency assignments in 21 European countries [3]

This allows the conclusion that the industry still sees the potential for wider scale BWA deployments; however, because of the fierce competition with other broadband technologies, BWA should be given all possible support to develop further. And here SM decisions may play a vital role, if they were to contribute to flexible and sustainable use of BWA technology and bands.

Problems Requiring Further Attention

The presented overview of the current situation with BWA networks in Europe shows that, in general, all of the necessary administrative prerequisites for their successful development are in place. Sufficient frequency bands have been identified for BWA, a large number of licences have been issued in most European countries, and technical conditions for the frequency use have been established.

However, a delay of wide-scale proliferation of BWA networks has now become a fact [4], which could not be ignored. It is now clear that the initial vision of BWA serving mainly (or only, as seen in some countries) residential markets will not materialise any time soon. On the other hand, the BWA is no longer the only alternative option for provision of broadband access, today seeing competition between many solutions, from ISDN and ADSL to the wireless LAN ("Wi-Fi") installations.

As these two assumptions of residential service and the prime competitive choice were the main shaping factor when developing BWA licensing regimes a few years ago, the resulting conditions included into licences may no longer be appropriate in a changed business environment of today. Besides providing the required service and ensuring market competitiveness, another aim of regulators when deciding licence conditions is to guarantee the most efficient use of allocated spectrum. In that respect, the attached service deployment obligations must ensure that the spectrum is not left unused or underused.

However, the regulators in some countries, which were first to licence BWA several years ago, are now facing a difficult challenge of deciding what to do with those licensees who have not fulfilled the licence terms. The licences are either returned to the regulator voluntarily or upon bankruptcy of the licensee, or are still held by the operators pending appropriate administrative action from the regulator. But the point is that today it is not clearer what BWA licences should prescribe in terms of intended services, deployment coverage and time scales, nor what conditions would ensure the best climate and guarantee for ultimate efficiency of spectrum use.

Therefore it seems that the BWA might be one of the cases, most requiring and, otherwise, best suited for applying novel market-driven SM methods, which could eliminate the problems associated with uncertainty in administratively established conditions of spectrum use. These novel methods are discussed in following sections.

II. Applying Spectrum Trading for BWA

Spectrum Trading

Secondary trading of radio spectrum (hereafter simply Spectrum Trading) allows transfer of rights to use licensed spectrum blocks (or radio frequency channels) directly between the undertakings, without the intermediary of a central SM regulator (Fig. 3). Sometimes such trade might be subject to a final authorisation from the regulator, but still the primary decision to trade lies with the licensee.

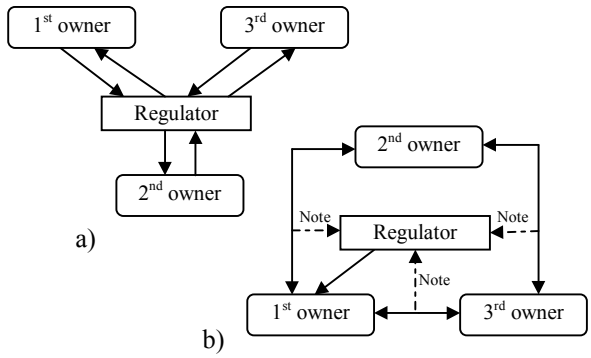


Figure 3: Transfer of spectrum use rights: (a) in a centralised SM regime, (b) with spectrum trading

The problems and questions associated with the introduction of spectrum trading are many, mainly originating from the need to combine the principle of free trade with a change-sensitive technical realm of a myriad cohabitant radiocommunications systems.

It appears that spectrum managers should embrace two major, yet contradictory aims when designing a regime for spectrum trading:

- to make trading most flexible and simple, to allow market mechanisms to work;
- to guarantee non-interference for radio systems.

To achieve these goals it is necessary to find a mutually optimal solution for at least these three principal questions:

(1) should the change of use be allowed initially and upon transfer of licence?

(2) how should a tradeable unit be defined?

(3) what non-interference safeguards should be attached to a tradeable licence?

The following sub-sections review these questions in greater detail and propose some solutions for particular case of tradeable BWA spectrum (licences).

Allowing Change of Spectrum Use

Allowing changes of spectrum use or not is a cornerstone question in all these deliberations, as the answer would define the compromise between the desire for highest flexibility versus the need of ensuring a predictable interference environment.

However, it is argued that for spectrum trading to work there is no other choice than to allow some dimension of change in spectrum use. A given type of spectrum use implies the same opportunity cost, defined as the value of spectrum "in its next best alternative use that is foregone by virtue of its actual use [6]." Hence restricting change of use would effectively mean fixing the opportunity cost of a given spectrum block, thus leaving little if any incentive to trade the right for that spectrum. So it seems that some change should be allowed, the question is how much. Because, on the other hand, the more change is allowed, the more unpredictable interference management might become in the longer term.

Significant changes of use, if allowed, may also distort the economic picture of the spectrum market as a whole. For example, if a holder of some block of BWA spectrum around 3 GHz would decide to use its spectrum for 3G/UMTS mobile services, imagine what that would mean for the value of spectrum held by existing (so far presumably exclusive) 3G licensees. These complex market implications of cross-dependence of trade of different bands are not yet considered in depth, even in the most recent comprehensive study of spectrum trading theory [6].

In this respect BWA might prove to be one of the easiest choices for introducing spectrum trading. It was already suggested [6] that for tradeable BWA spectrum blocks the change of use might be allowed within the limits prescribed by the regulatory definition of the fixed radiocommunication service, of which BWA is one of the applications.

Indeed the ITU Radio Regulations (ITU RR) [7] describe Fixed Service as a radiocommunication service between specified fixed points. However, currently BWA licences are much more specific than that and either specifically prescribe or imply the use of so called point-to-multipoint (star) network configuration, with one central station serving a cluster of remote users. If the licence requirements would be relaxed just to follow the general definition of fixed service, it would immediately allow use of the spectrum for many more network configurations and service applications (Fig. 4, top).

Furthermore, it appears that for the millimetre BWA bands at 26/28/40 GHz it should be reasonably straightforward to allow change of use within the limits of not only fixed, but also mobile radiocommunication service. This could happen in those parts of the bands where relevant provisions of the ITU RR and national frequency allocation tables [7, 8] allow both fixed and mobile service.

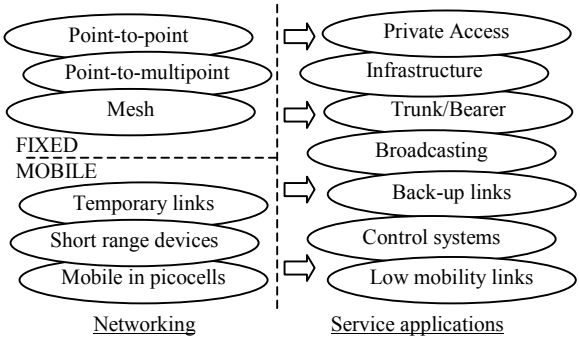


Fig. 4. Possible network topologies vs. applications within the Fixed and Mobile Services at mm-bands (26/28/42 GHz)

It should be possible to use links under mobile service designation because a significant atmosphere attenuation at these frequencies will anyway require either using very high directivity antennas (hence resembling fixed service, but e.g. from unspecified locations) or having a very limited communication range for mobile devices with non-directional antennae.

Therefore it seems that opening of both fixed and mobile use within the tradeable spectrum in mm-bands, subject only to general limits imposed by the international regulations such as ITU RR, would result in a still limited set of networks and provided services (see Fig. 4), hence controllable interference potential. However, it would give sufficient freedom to spectrum owners and users to exploit their resource to a full technically feasible extent.

Such limits, imposed effectively by the physical features of the mm-bands in question, would also not endanger a balance in the lower spectrum bands, where, for example, an unexpected development of public mobile service in a "new" band might lead to jeopardising of spectrum valuation in cross-related bands and services.

Definition of Tradeable Spectrum Units

For the discussed case of trading the European BWA licences and spectrum bands, it might be recommended to follow the conceptually simplest option of defining tradeable spectrum units as frequency blocks with associated geographic area of operation.

This approach suits both cases well, when spectrum trading is adopted for newly licensed bands and when it might be introduced into the previously issued BWA licences, as the current BWA licences used to be issued per frequency blocks and associated with particular geographic area – either national or regional coverage. The blocks of spectrum attached to previously issued licences were of a size in the order of 2x(56…112) MHz,

which was deemed sufficient for wider-scale deployment of the BWA networks of given type.

If trading were to be introduced now for BWA licences, a reasonable option would be to define tradeable spectrum units in a size of the smallest channel in a fixed service channel raster for a given band, e.g. 3.5 MHz for the 26/28 GHz bands as stipulated in [9]. Positioning of these tradeable units should also follow the same channelling arrangements for given band. Naturally, future licence holders should be allowed to aggregate as many tradeable units/channels as they consider necessary, while the existing licence holders may be allowed to partition their current spectrum blocks into the same single tradeable units with possibility of re-selling them one by one.

Block Boundaries

Another very important issue to consider in defining tradeable blocks is that of the provisions regarding the boundary conditions of the licensed blocks. As mentioned, these boundaries should be associated with given geographic area limits and certain power flux density limits, which would guarantee that no interference spills over into neighbouring blocks/countries (see also the following sub-section on interference safeguards).

In reality, there will be many cases when licensees want to operate a radio station close to the block border, raising the issue of potential interference to the neighbours. There are two principle ways to address this issue. One is to require simply that no transmitter within the block exceeds the safe power flux density at the block border (e.g. see description of Australian concept of a *device boundary* in [10]).

Another way, which is promoted here, is that the power flux density limit at the boundary should be set to the conservative value, but it should be used only to trigger co-ordination with a neighbour, be it an owner of a neighbouring spectrum block or a neighbouring country. In that way the block owners may have better flexibility in achieving closer location of their stations to the block edges, subject to negotiated agreements with a neighbouring party.

But the outstanding question here is how these negotiations affect the definition of block boundary. One of the studies on this subject [11] concluded that any co-ordination agreements should be seen as a change of boundary conditions (may be interpreted either as change of agreed power flux density at the boundary or transposing the geographical boundary of the block). This conclusion was then transferred into the study [6], resulting in a recommendation that all such negotiated changes of boundary conditions should be recorded in a public database and should become part of legal definition of the block in question. That is, if the block is later traded, it should be transferred to the new owner retaining all changes to boundary conditions.

However this concept does not seem to apply well to the reality of radiocommunication services and to the nature of co-ordination agreements, where spectrum-area space occupied by radio stations is not so obviously linked to the physical area boundaries. First of all, applying such a concept of changing block boundaries would result in unnecessary and meaningless fragmentation of block boundaries in the long term, which would be increasingly difficult to record.

Secondly, and most importantly, the co-ordinated interference spill-overs will not protect from actual interference happening if the configuration of stations in the originating block has changed, see example shown on Fig. 5. Note that station X of a neighbour in the example in Fig. 5 was and remained in the agreed area of interference spill-over, but in the second case interference may occur because of a different angle of arrival of the interfering signal.

To avoid such situations co-ordination of the stations that may exceed radiation limits at the block boundary should be seen only as a consent to install and use that particular station (i.e. at particular site and with particular technology/link parameters). Further licence provisions should stipulate that such a co-ordination agreement remains valid as long as the subject station remains in use, irrespective of whether the ownership rights for that station or the whole spectrum block have been transferred or not.

But if a station was to be removed or its parameters changed, then the co-ordination agreement would be deemed void. Placement of a new station should also require a separate co-ordination agreement, even if it would be producing interference into the areas, already "illuminated" by previously co-ordinated station, see Figure 5 (b).

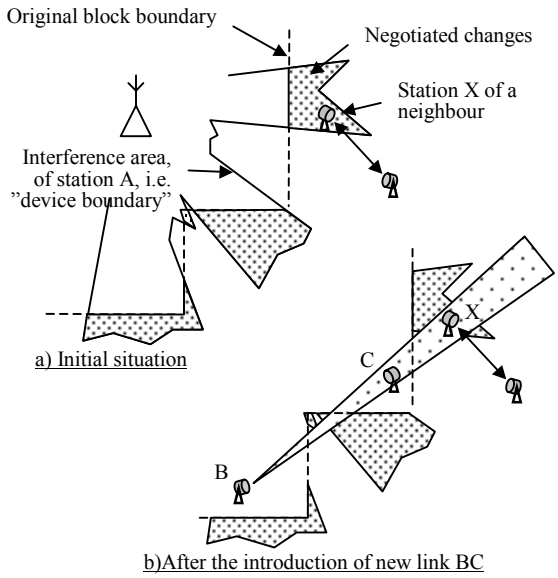


Figure 5: Possible scenario at the block boundary:
(a) no interference to station X in a neighbouring block,

(b) (b) possible interference to station X

With such regime any trade of spectrum blocks would be carried out without changing their original boundaries, but carrying over the permission to use co-ordinated stations in border areas, if a new owner would be interested in maintaining them.

It is normally assumed that the block owners should be themselves capable of performing such co-ordination with owners of neighbouring blocks, while co-ordination

with neighbouring countries should be effected through the national regulator [6, 11].

Safeguarding Against Interference

The main interference safeguard for the discussed environment of BWA licences and frequency bands should be the establishment of a certain limit of allowable power flux density at the block boundary, to ensure interference free operation in geographically adjacent areas. Its application and co-ordination of stations in areas near the block boundaries was already discussed in the previous sub-section.

In addition to that, operations in adjacent frequency blocks could be protected by the establishment of appropriate out-of-band (i.e. out-of-block) emission limits in form of a block edge mask.

The overall interference management should be further assisted by the establishment of a clear methodology to be used in co-ordination of border stations and resolution of potential cases of interference. This methodology should include tools for interference assessment, propagation models, etc.

Another necessary measure, already well justified in other sources [6, 10, 11], is the creation of national databases (registers) of all issued licences, their boundaries and associated conditions (power flux density, etc.) as well as the list of all mutually co-ordinated stations near the block boundaries.

International Harmonisation Measures

Consideration of particular cases of BWA bands, in particular bands at 26/28/40 GHz, also allows finding a reasonable compromise for the solution of principal incompatibility of spectrum trading and service neutral licensing with the aims and provisions of international harmonisation.

As was already argued, the general definitions of fixed and mobile services should be possible and sufficient limits for ensuring flexibility in those portions of the BWA allocated bands at 26/28/40 GHz, where ITU RR and the national frequency allocation tables allow mobile services.

At the same time, it may be considered that once a regulator has made it clear that the BWA is allowed in these bands, in accordance with the relevant harmonisation initiatives of e.g. CEPT on European level, it would provide sufficient basis for harmonised introduction of these services.

Then it would be left purely to the market to exploit the potential advantages of BWA harmonisation by deploying BWA networks in parts or whole of the available spectrum, or to deploy another system where BWA does not fulfil profitability objectives.

If the market situation is different in a neighbouring country and operators there made a different choice, the interference should not be a problem in these high frequency bands, if appropriate boundary conditions are carefully selected and enforced.

III. CONCLUSIONS

The spectrum trading appears to be a promising SM tool, which is inherently well adapted to the market-driven radiocommunications environment of today. However, if it were allowed across the wide spectrum ranges, in the longer term it could result in a highly fragmented spectrum use and hardly manageable interference. But introduced in a carefully selected limited number of frequency bands, it could catalyse the use of those frequency bands significantly.

Therefore this Annex attempted to show that the existing BWA licences and newly licensable blocks of BWA spectrum may be one of the easiest choices for introducing and bench-testing the concept of spectrum trading and service neutral licensing in Europe.

It appears that the market environment for BWA services, physical properties of the allocated mm-bands and other related circumstances should make the introduction of spectrum trading there a reasonably elementary exercise.

Besides giving valuable hands-on experience of spectrum trading in European environment, the introduction of such a SM regime would also open new opportunities for the sustainability of BWA business and the most efficient use of BWA spectrum.

REFERENCES

[1] W. Webb, *Introduction to Wireless Local Loop, second edition: Broadband and Narrowband Systems*. Artech House Publ., 2000.

[2] H. Bolcskei, A.J.Paulraj, K.V.S. Hai, R.U. Nabar, W.W. Lu, "Fixed Broadband Wireless Access: state of the art, challenges, and future directions," *IEEE Comm. Mag.,* Jan. 2001, pp.100-108.

[3] *Fixed Service in Europe: Current Use and Trends Post-2002,* CEPT/ECC Report 03, February 2002, available at http://www.ero.dk/.

[4] *The Development of Broadband Access Platforms in Europe,* Study by BDRC Ltd. for European Commission, August 2001.

[5] Directive 2002/21/EC "On a common regulatory framework for electronic communications networks and services" *EC O.J. L108, 24.4.2002*.

[6] *Review of Radio Spectrum Management,* Study by Prof. M. Cave for DTI & HM Treasury, UK, March 2002, available http://www.radio.gov.uk/ .

[7] *Radio Regulations. Vol. 1: Articles,* International Telecommunication Union, Geneva, 2001.

[8] *ERO Frequency Information System,* ERO, Copenhagen, accessible at http://ww.efis.dk/.

[9] *Preferred Channel Arrangements for Fixed Services in the range 22.0-29.5 GHz,* CEPT/ECC Recommendation T/R 13-02 (Montreaux, 1993), available at http://www.ero.dk/.

[10] M. Whittaker, "Shortcut to harmonization with Australian spectrum licensing," *IEEE Comm. Mag.,* Jan. 2002, pp.148-155.

[11] *Implications of international regulation and technical considerations on market mechanisms in spectrum management,* Report by Aegis Systems Ltd & Indepen Cons. Ltd, Nov. 2001.