

**Commission of the European Communities
Directorate General XIII**

**Study on analysis of new methods of frequency allocation in the
Member States and comparative analysis of recent
developments in this field**

FINAL REPORT

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**Coopers
& Lybrand**



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allocation in the Member States and comparative
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Report to the Commission of the European Communities

MAIN REPORT

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Final Report to the Commission of the European Communities DGXIII

This study, "Study on analysis of new methods of frequency allocation in the Member States and comparative analysis of recent developments in this field", has been prepared for the Commission of the European Communities. It has been commissioned as one of a series of independent studies which are intended to support the CEC in developing its green paper on Mobile Communications, which is expected to come out at the end of 1993.

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Management Summary

1 Mobile and wireless communications (including personal communications via hand-held terminals) represent a particularly important and dynamic area of the telecommunications sector, itself one of the most rapidly developing markets in the EC. Technology developments, commercial imperatives and the awareness of the user community have led to changed structures in the mobile service industry over the last ten years; progress towards a competitive market-oriented industry base which benefits Europe's economy and its citizens is now a priority issue for CEC policy makers.

2 Community telecommunications policy, especially since the 1987 Green Paper, has concentrated primarily on the market for fixed services. The success of these policy developments, which emphasise the role of competitive supply in delivering economic benefits through telecommunications, has provided a spur to further consideration of the satellite and mobile sectors; at the same time recognising that the reliance of these services on the finite radio spectrum imposes particular difficulties for opening up the market. Accordingly the CEC is developing a Green Paper on Mobile Communications in the EC and in support of this process is studying certain key aspects of provision, including developments in technology and service demand, licensing of operators and providers, and the important issue of management of the radio spectrum.

3 This study, undertaken for the CEC in the first half of 1993, was established to identify areas of common approach to frequency management which would contribute to policies for development of the mobile and personal communications sector in the Community, and to propose actions necessary to achieve these goals.

4 Mobile communications is inherently dependent on radio links. However, the radio spectrum must also accommodate other civil and Governmental telecommunications uses as well as other service applications including broadcasting, navigation, astronomy and scientific and industrial uses. Spectrum management is conducted within an international treaty framework (the ITU) providing for periodically agreed world and regional allocations of frequency bands to broad classes of service usage; this administrative process is aimed at ensuring that service applications are enabled and that harmful interfering transmissions across national borders are avoided. More specific allocation planning and the assignment of frequency usage rights to particular operators are national responsibilities, with cooperation and coordination activities amongst regional neighbours.

5 The study has been successful in identifying a wide range of common positions which can form the basis for harmonised policy in this area, and has raised a number of further issues which warrant attention, including commercial aspects of frequency rights.

6 In broad terms the study identified six key areas in frequency management as a focus for issues which should be addressed by EC policy makers :

- Open procedures in frequency management;
- Frequency harmonisation for pan-European services;
- Effective usage of spectrum resources;
- Spectrum for emerging services for personal communications;
- Infrastructure for competing fixed-networks;
- Frequencies for cross-border operation.

For each the study has proposed a number of common positions together with lines of actions for the CEC. These are presented in Tables 1 - 6.

7 On *open management*, there is a strong trend in Europe and elsewhere towards open public processes for both allocation of frequency bands and assignment of frequency usage rights in certain cases - although there is little commonality in detailed national procedures. The

study makes proposals for the general adoption of principles embodying transparent and public dealings, objective evaluation criteria, and equality of opportunity for potential users in member state procedures both for allocation and planning of spectrum usage and for the assignment of frequency rights to operators.

8 There is wide consensus on the value to the equipment industry, to network operators and to consumers, of *frequency harmonisation* for systems and services with a pan-European dimension, but emphasising the need for agreements to encompass the broader European region as well as the EC. European harmonisation through EC legislation in conjunction with technical Recommendations of the CEPT has not been wholly successful, but with the adoption of new CEPT procedures in this area the study endorses EC intentions to pursue further European frequency harmonisations primarily through agreements and commitments within the context of CEPT ERC Decisions. It is further proposed that the CEC should support this harmonisation activity with technical studies (including demand assessments) and promotion of closer collaboration amongst industry contributors and in civil-military frequency management.

9 Regarding *effective spectrum usage*, current spectrum management in EC member states has enabled the introduction of significant competition in public mobile communications services. However, development of the mobile communications market - through new services, technologies and competitive structures, more universal penetration, and continuing opportunities for private networks - will require the availability of increasing amounts of spectrum in frequency bands technically suited to mobile operations. At the same time demands for spectrum for other service applications and non-civil uses are changing and must also be recognised. The study proposes that common guidelines should be developed for good spectrum management practice in member states, including positive action to re-farm parts of the spectrum and to maintain incentives for increasingly efficient use of frequencies. In particular member states should be encouraged to incorporate in their assignment approaches, direct pressures for operators to invest in more effective exploitation of frequency resources through the application of economic pricing factors for frequency use or through the imposition of technically defined requirements. The study further recommends that the CEC should support this process by developing a body of background data to assist comparison and assessment of alternative approaches in this area of spectrum management.

10 *Personal communications services* (including mass-market communications via hand-held terminals) will be the prime focus for developments in mobile telecommunications over the next two decades, with early services already emerging (PCN in Germany and the UK) and prospective USA based providers already planning for extended global coverage through satellite systems. The study proposes that the CEC should identify and promote European interests in satellite components of these services (encouraging consistent frequency planning positions for member states participating in world fora for allocation), and for PCS networks in general should develop a common view on the strategic evolution of this market for mobile communications in the EC as a framework for the timely availability of frequencies for both terrestrial and satellite systems.

11 Radio-based local access networks can provide a rapidly constructed and cost-effective alternative to cable installations for development of the fixed public networks. In the liberalised UK market, competition in local telephony service, slow to emerge through cabled systems, is being further encouraged through the licensing of new operators intending to deploy radio access systems. With respect to *infrastructure for fixed telecommunications services* the study proposes that, in the event that the EC develops policies for competition in providing such network facilities, appropriate frequencies should be made available in EC member states to enable wireless local loop construction by new market entrants and that the CEC should support studies into this use of the spectrum.

12 On the use of frequencies in multi-national networks and for *operation across national borders*, the CEC is recommended to initiate work towards a convergence of national frequency licensing procedures through a study of commonality in required items of supporting

technical data, and in the case of PMR networks to investigate the prospect for coordinated regulation and procedures to authorise cross-border transmissions.

13 The regulatory situation for authorisation of frequency usage in member states shows some basic common features, but also a wide variation in adopted practice. The regulatory bodies for civil radio usage are all independent of direct network operational interests, and all currently conduct national spectrum management on a centrally administered basis, through which allocation and assignment of frequencies is available for the broad range of public and private mobile communications services. However, detailed national procedures for authorisation of service network operation and the assignment of frequencies vary widely; work within CEPT in 1992 concluded that there was little prospect for convergence on common authorisation procedures in this area.

14 A consistent theme throughout the course of the study was the emerging level of debate over the role for commercial pricing of frequency rights and the inconclusiveness of current arguments concerning its practical application in promoting effective exploitation of the spectrum.

15 The technical and physical constraints of radio propagation; treaty obligations; requirements to avoid harmful interference between users and across national borders; the range of social, scientific, safety and security applications as well as commercial exploitation of radio links; the preponderance of large, usually government related, system operators; all these factors have contributed to the adoption of 'centrally administered' regimes which, to date, have been deemed the most effective means for planning and enabling spectrum usage in European countries. The EC's declared desire for harmonised pan-European services and single markets reinforce this. Within the treaty obligations of the ITU Radio Regulations, Europe's approach to fundamental allocation of spectrum usage is bound to remain an administrative one.

16 However, as the market for telecommunications services and networks (in particular) becomes generally opened and commercialised at all levels, in line with overall policies for the sector, a real question arises over how to reconcile this with an ordered access to limited spectrum resources, without an escalating and inflexible burden of administrative control. This issue emerges in the question of economic prices and markets for frequency usage rights.

17 The proponents of resource distribution through free market forces (in which frequencies are assigned in accordance with the mechanism of pricing) hold that through such a non-centralised system, frequencies will tend to be employed in those uses on which consumers place the highest value. Evidently administrative rules have a part to play in promoting coordinated policies and in achieving particular technical and political objectives in member states. But in economic terms where frequency availability is under pressure (eg in densely populated metropolitan areas), a system of usage-allocation and assignment which took no account of users' ability- and willingness-to-pay could lead to significant losses of efficiency.

18 Key features of a market-based approach should be an initial auction of usage rights for available frequencies to the highest bidder, with subsequent freedom to transfer or re-sell usage rights with as few restrictions as possible on the use to which frequencies are put. Transferability is important if this allocation and assignment system is to respond efficiently to changing conditions in the market for telecommunications services. A price-market in frequencies might be the most effective approach for assignment amongst a number of operators directly competing in the same service (and allocated spectrum band). Ability to trade frequency rights, even without change of usage, could allow the competing networks to support different growth and commercial success patterns, and best meet consumer needs - without requiring repeated administrative assessment by a regulator for additional or varied assignments. Some change of use (eg for new technology) might also be accommodated in such a limited spectrum market. Providing there is service and price competition, operators

should not be in a position to bid high frequency payments in the expectation of passing such costs on to consumer tariff levels.

19 Nevertheless, it is likely that a range of administrative rules alongside any spectrum market would be necessary - to sustain established usage rights and non-commercial applications; to ensure recompense for existing users relocating from newly designated frequency bands; to prevent bottleneck holdings of frequencies, without recourse to broad competition law; and to constrain changes of use and technology to protect others from harmful interference.

20 Against this background it is our view that an increasing commercialisation of frequency rights (particularly in assignment for commercial exploitation) should play a role in more dynamic development of the mobile and personal communications sector in the EC. However, many factors in the fields of social, industrial, and competition policy as well as in technical coordination commitments will combine to limit practical opportunities for the application of price-based markets for frequency usage rights in Europe. Frequency management methods employed in member states may vary, in the spirit of subsidiarity, and a range of economic and non-economic factors within an administrative approach could also be deployed by member states to exert pressures for increasingly effective use of frequencies. Indeed, continued administrative planning and controls will be needed to sustain overall Community and national policy goals for telecommunications and radio usage.

1 Open procedures in frequency management

1.1 Issues

- 1.1.1 Until recently, in European countries the radio spectrum has been used predominantly by large, government related bodies providing and supporting public service functions. In this context administrative procedures for spectrum management (including planning, allocation to uses, and assignment to operators) developed which were largely closed to those outside the regulating administrations and various operating entities.
- 1.1.2 In the USA, in contrast, private sector operators have been the norm in both broadcasting and telecommunications; competing radio-facility operators (both for public and private telecommunications use) have been accommodated by liberalising regulation for some decades - and not just for PMR networks. This culture has been reflected in administrative procedures for spectrum management which are conducted largely in the open, on public record, and open to public consultation, proposal and challenge.
- 1.1.3 Spectrum management remains a sovereign function for member states. But as liberalisation of European network markets proceeds, and the range of players, options and interests to be accommodated widens significantly, spectrum management procedures must allow for more informed consensus in planning and allocation of spectrum use and support fair competition in frequency assignments to operators. Some member states have already started this process through public reviews of spectrum usage and through open tender procedures for certain licence awards.

1.2 Proposed positions

- 1.2.1 Member states should embody open and objective principles in national procedures for spectrum allocation and usage planning (including those for determination of maximum operator numbers in a band).
- 1.2.2 For assignment of frequencies to operators, member states should adopt open and objective procedures which, for a given usage, ensure equality of opportunity for potential operators (except in objectively justified cases).
- 1.2.3 Member states should, when planning for frequency usage in commercially offered mobile services, make due provision for competing multiple infrastructure operators.

1.3 Proposed actions for CEC

- 1.3.1 The CEC should prepare a recommendation (or other appropriate measure) to introduce guidelines for NRAs in member states on incorporation of open and objective principles in their frequency management procedures, and to enable the periodic review of these procedures by the CEC in the light of effective availability of spectrum for new services and the progress of competitive service provision in the Community.

2 Frequency harmonisation for pan-European services

2.1 Issues

- 2.1.1 ITU radio regulations, established at periodic World Administrative Radio Conferences (WARC) define the broad allocation of spectrum uses to which national and regional provisions must conform. However, considerable opportunity for options, alternatives and more specific designations exists and historically the national tables of frequency allocation in member states have diverged to an extensive degree.
- 2.1.2 The benefits of harmonised frequencies in supporting common equipment markets and service availability across Europe are well recognised and agreed; European cooperation in this area is much more developed than in other parts of the world, and has resulted in coordinated availability of frequencies for the introduction of digital mobile services in the EC. However, regional concerns for harmonisation extend widely beyond the EC and the use of EC legislation for committed frequency harmonisation has not been viewed as wholly satisfactory.
- 2.1.3 Multilateral cooperation amongst state administrations of the whole European region is proceeding within the context of CEPT, where new initiatives include spectrum reviews towards a long-term common allocation of spectrum use and Decision procedures which introduce national commitments to implement harmonised frequency provisions. However, these arrangements remain voluntary and have not yet had time to show practical results.
- 2.1.4 Criticisms of past harmonised frequency provisions for particular new services in Europe include a lack of strategic priorities, insufficient reflection of national and regional service market circumstances and some failures in detailed technical coordination to avoid prospective inter-service interference.

2.2 Proposed positions

- 2.2.1 The CEC and member states should encourage and support work through CEPT towards establishing in the long-term a common European table of frequency allocations.
- 2.2.2 The CEPT ERC Decision process should be considered by the EC as the primary route to achieving harmonised frequency allocations, usage, and availability in Europe. The CEC should monitor and review the effectiveness of this process in achieving the requirements of telecommunications policies adopted by the EC; should adequate and timely harmonisation of frequencies not be achieved in member states in particular cases then the CEC should initiate appropriate EC legislative measures to ensure such harmonisation in the EC.
- 2.2.3 Greater collaboration should be encouraged amongst the various groups contributing to the process of frequency harmonisation in Europe, in particular to incorporate expertise in market and implementation economics.

2 Frequency harmonisation for pan-European services

2.2 Proposed positions (contd)

- 2.2.4 Prospective frequency harmonisation activities for telecommunications systems and services with potential for pan-European implementation should be supported through the development of common EC positions identifying (inter alia) the EC's strategic view on market prospects and associated spectrum requirements in relation to the relevant systems or services; the impacts of a competitive supply regime and of necessary band clearance programmes should be included in assessments of common spectrum requirements.
- 2.2.5 To ensure that the full benefits of newly introduced mobile systems are realised in practice in the EC, it is vital that radio performance characteristics and operational frequencies are chosen and matched after a thorough assessment of impacts both for the new system and on existing or planned users in adjacent frequency bands. To this end, technical liaison between ETSI and the ERC on radio-frequency related matters should be ensured through a formal framework for cooperation between these bodies. The EC should encourage and assist in the achievement of such cooperation.
- 2.2.6 Member states should strengthen civil-military cooperation on spectrum planning, supported by the CEC in particular for planning on a pan-European basis and cooperation with NATO.

2.3 Proposed actions for CEC

- 2.3.1 The CEC should complete as rapidly as possible, Memoranda of Understanding with the CEPT committees ERC and ECTRA, and framework agreements with their permanent offices ERO/ETO.
- 2.3.2 To follow up the Council Resolution of 19 November 1993, the CEC should propose a further resolution elaborating the basis on which EC objectives for frequency harmonisation are anticipated to be achieved primarily through ERC Decisions.
- 2.3.3 The CEC should sponsor studies of strategic market prospects and associated spectrum needs as appropriate for mobile systems with pan-European characteristics, where relevant through work requirements to ERO/ETO; the CEC should encourage extensive industry consultation and participation in this work.
- 2.3.4 The CEC should consider development of a formal relationship with NATO (through the ARFA) to examine European spectrum issues.

3 Effective usage of spectrum resources

3.1 Issues

- 3.1.1 The overall aim of spectrum management is to optimise benefits from the many commercial and non-commercial uses of national spectrum resources; international treaty obligations require some central administrative supervision and control.
- 3.1.2 The developed economies, dense population concentrations, and multiple border zones which characterise Europe require management approaches which recognise that few significant frequency bands remain unoccupied and that common usage and coordination against harmful interference are of prime importance.
- 3.1.3 To meet increasing demands for frequencies (especially in the range of spectrum which is technically well-suited to mobile communications applications) there is a trend for increasing administrative intervention with more specific technical planning, operator selection and usage controls ; greater flexibility and lower burdens of administration might be offered if use of significant parts of the spectrum could be adequately determined by potential operators through market-price mechanisms.
- 3.1.4 A range of management methods to encourage more effective and beneficial spectrum exploitation have been tried or proposed, based on targeted administrative conditions or elements of market-value pricing. Comparative arguments have been inconclusive and little data exists on technical or economic characteristics of the alternatives.
- 3.1.5 At present, access to spectrum which could support the developing mobile communications market is impeded in a number of member states through long-term block allocations for exclusive use by particular (civil or military) organisations and through administrative problems in funding the relocation of existing users in the course of changing usage in selected frequency bands.

3.2 Proposed positions

- 3.2.1 Member states should be encouraged to publish national allocation tables and to make non-sensitive summaries of frequency assignments available for consultation by potential users, manufacturers and other interested parties.
- 3.2.2 Member states should follow active programmes to increase availability of frequencies in established bands for civilian mobile communications. These programmes may include national reviews of spectrum occupancy and usage, flexible sharing with military users and the development of strategies for replanning of frequency bands.

3 Effective usage of spectrum resources

3.2 Proposed positions (contd)

- 3.2.3 Member states should be encouraged to adopt frequency allocation and assignment policies which impose upon mobile network operators conditions (based on technical and/or economic factors) promoting the increasingly effective exploitation of assigned frequencies. A licensing approach which incorporated technical criteria might specify efficiency measures such as that of channels/MHz/square km achieved for some part of the operator's network; the use of digital transmission and TDM multiplex techniques; or more progressively by requirements to have introduced narrower channelisation or lower-rate coding and compression schemes by a nominated stage.
- 3.2.4 The CEC should develop a view on the role of the price mechanism in economic approaches to frequency management. This view should take account of price-oriented administrative methods (the setting of premium fees for scarce frequencies) and of market-based methods, including spectrum auctions. Economic approaches to the funding of band clearance, which consider the expenses of re-tuning of equipment and costs incurred by existing users of migration further up the spectrum should also be considered.
- 3.2.5 The EC should encourage and support the extension of current multi-lateral cooperation on frequency coordination towards a general agreement for frequency coordination in border areas for CEPT member countries (and particularly throughout the EC).

3.3 Proposed actions for CEC

- 3.3.1 The CEC should place work requests on ERO/ETO as appropriate to develop common guidelines for good practice in spectrum management in member states, to cover areas including:
- publication of information on allocations and assignment summaries;
 - active programmes for spectrum release;
 - effective spectrum exploitation criteria in assignment procedures.
- 3.3.2 The CEC should initiate a programme of studies (through ERO/ETO or otherwise) to develop a base of technical and economic information to assist the comparison and assessment of alternative management approaches aimed at increasing the effectiveness with which operators exploit assigned spectrum.
- 3.3.3 The CEC should consider placing a work request on ERO to develop the structure and terms for a general agreement on frequency coordination in border areas of the EC.

4 Spectrum for emerging services for personal communications

4.1 Issues

- 4.1.1 Personal communications services (PCS) are expected to provide mass-market communications supporting mobility through hand-held terminals, coverage in any location, and ultimately image and other broadband capabilities as well as voice and data links. The PCS concept will continue to evolve for many years (including through RACE projects and standardisation activity in ETSI and the CCIR) and spectrum planning should therefore retain flexibility.
- 4.1.2 EC member states are adopting different policies in implementing forerunner PCS services such as PCN (higher density cellular provision) and DECT (cordless telephony), for which adjacent frequency bands have been identified but not fully harmonised in Europe.
- 4.1.3 The role of mobile satellite systems (including so-called LEO satellites) in providing or extending PCS coverage is still in debate (both in conjunction with second generation terrestrial systems such as GSM or PCN, and as part of a future integrated third generation approach). The USA, with a high proportion of domestic territory sparsely populated and unlikely to be served by terrestrial mobile networks, has shown earlier market and industry interest in satellite service components for PCS than has Europe.
- 4.1.4 Worldwide frequency allocation for PCS applications shows little commonality for near term systems (and equipment markets) and although the WARC of 1992 identified worldwide frequency bands for proposed third generation approaches, major disparities were introduced in regulations scheduling when allocations for mobile satellite sub-bands come into effect; access to such spectrum use for the USA is currently permitted from 1996 - almost 10 years ahead of the European region and the rest of the world.

4.2 Proposed positions

- 4.2.1 To support development of personal communications services in the EC and to enable a cohesive European position to be promoted in world fora for spectrum planning, a common EC position should be developed and agreed on the role of satellite systems in providing personal communications and the associated requirements for frequencies for the mobile satellite service and their planned availability in the European region and elsewhere.
- 4.2.2 To provide a strategic framework for long-term frequency management and planning for personal communications services (PCS) and future public land mobile telecommunication systems (FPLMTS) in Europe, a common EC position should be developed and agreed on the broad prospects for the evolving service market (including opportunities for competition and for innovations in technology) and associated options for meeting spectrum requirements for personal communications systems.

4 Spectrum for emerging services for personal communications

4.3 Proposed actions for CEC

- 4.3.1 The CEC should commission a wide ranging study of the role of satellites in delivering PCS in Europe and associated frequency requirements. Subsequently the CEC, through ERO, should seek agreement within CEPT on appropriate European Common Proposals incorporating such MSS frequency requirements to guide member state participation in future Regional and World Administrative Radio Conferences.
- 4.3.2 The CEC should commission a market oriented study of the potential evolution of PCS and FPLMTS services in the EC, including spectrum implications. The CEC should ensure that relevant results are contributed to the CEPT Detailed Spectrum Investigation process, and should consider preparation of a Council Resolution to endorse a common strategic direction for PCS and FPLMTS in the EC.

5 Infrastructure for competing fixed-networks

5.1 Issues

- 5.1.1 Little consideration has as yet been given in most member states to stimulation of the telecommunications market through regulation to enable competition in the provision of public fixed-network infrastructures, but this is extensively developed in the UK as well as in the USA and Japan.
- 5.1.2 Radio systems can offer a rapid and cost-effective alternative to cable construction in competing networks, for trunk links but also more significantly for subscriber local loop facilities. Without practical options for radio construction, competing local services could be slow to develop - although concerns may arise over potential environmental intrusion of base installations or over possible radiation hazards.

Standards and designated frequencies for wireless local loop systems have not yet been established; alternatives include approaches previously conceived for truly mobile applications.

5.2 Proposed positions

- 5.2.1 In the event that EC policies are developed for competition in provision of public network infrastructure and telecommunications services, appropriate frequencies for wireless local loop operation should be made available in all member states, to meet the commercial needs of authorised network operators.
- 5.2.2 Member states should be encouraged to provide frequencies for wireless local loop operation for fixed-network infrastructure in a way which does not significantly impede the development of services to mobile users in the EC.
- 5.2.3 Studies assessing possible technologies for wireless local loops and their associated spectrum options are needed to provide background information for spectrum planning in this area in member states.

5.3 Proposed actions for CEC

- 5.3.1 If EC policies are developed for competitive fixed network infrastructure provision, the CEC should support these through proposal of a Council Recommendation calling for appropriate frequencies for wireless local loops to be made available in member states, and enabling the CEC to review its application in the light of subsequent progress in the development of competitive markets.
- 5.3.2 The CEC should consider placing work requests on ERO/ETSI (or others) as appropriate to study a range of technical options for wireless loop applications, their associated spectrum requirements, and the potential for European harmonisation in this field.

6 Frequencies for cross-border network operations

6.1 Issues

- 6.1.1 Trans-European networks and services are a cohesion target for further development of the EC. For mobile communications this could be achieved through further development of interoperation and user-roaming amongst nationally based networks. Alternatively, particular operators might seek to provide new multinational networks with radio transmission and service coverage which span national borders.
- 6.1.2 National regulatory procedures for mobile network licensing and radio frequency assignment vary considerably. For public service provision (where special rights will typically restrict the number of competing infrastructure networks) the multi-national synchronisation of licence awards to span borders has not yet been addressed. In practice, single networks with cross-border coverage could be of more importance for private operators to support dispatch applications within an organisation.
- 6.1.3 Schemes are in operation for multi-lateral coordination of frequency usage in border areas (to avoid harmful cross-border interference), although no single arrangement includes all member states. These schemes must be based on extensive commonality in spectrum allocation to relevant service use in the participating countries.

6.2 Proposed positions

- 6.2.1 As a contribution to possible rationalisation of national regulatory procedures for authorising operation of mobile service networks with radio infrastructure, a valuable preliminary step would be agreement on common sets of technical and engineering information items needed to support a system operator's request for assignment of frequencies.
- 6.2.2 Particularly in the context of self-provided networks for private mobile radio service, the EC should seek development of regulatory approaches which would enable authorisation of mobile network operation with planned cross-border radio propagation and service coverage.

6.3 Proposed actions for CEC

- 6.3.1 The CEC should consider placing work requests:
- on ERO to identify, for a range of mobile radiocommunications service types, common sets of technical/engineering information elements necessary to support an assignment of frequencies for use with relevant network systems - suitable as guidelines for common practice in member state procedures for assignment;
 - on ETO to propose a regulatory approach for authorising cross-border operation of PMR networks in the EC.

1 Introduction and background

1.1 Introduction

1 This final report presents the results of "Study on analysis of new methods of frequency allocation in the Member States and comparative analysis of recent developments in this field" undertaken by Coopers & Lybrand for Directorate General XIII of the European Commission (CEC).

1.2 Study background

2 The CEC is currently drafting its green paper on Mobile Communications, which is expected to come out at the end of 1993. The green paper will focus on regulation to support liberalisation of the mobile services market. The results of this Coopers & Lybrand study, and of two parallel studies on "Analysis of Current Licensing and Declaration Procedures" and "Future Trends in Technical Development and Commercial Provision" are intended to support the CEC in developing this green paper.

3 The study focused on definition of "Potential Areas for a Common Approach to Spectrum Management" to support the CEC in developing the green paper.

4 Initial phases of the study comprised gathering information to test Proposed Common Positions within Potential Areas for a Common Approach to Spectrum Management. These potential areas for a common approach were agreed with the CEC and provided a focus for review of the current environment in both the European Community (EC) and Organisation of Economic Cooperation and Development (OECD) countries.

5 Spectrum managers in each of the member states were provided with copies of the initial set of possible positions and actions which were identified within each of the six potential areas, and were invited to put forward their views on these. A number of interviews were carried out with national spectrum managers, members of the European Radiocommunications Office and selected industry representatives. Several modifications and additions were made to the proposed positions and actions on the basis of our discussions with these key players.

6 On the basis of further analysis, evaluation and consolidation of this information, a refined set of proposed positions and actions for the CEC were produced.

1.3 Structure of the report

7 This final report is structured as follows:

- Management Summary.
- Chapter 1 is this Introduction.
- Chapter 2 examines the European and international institutional environment for spectrum management and presents an overview of EC telecommunications policy and spectrum policy goals.

The six areas identified for a common approach in spectrum management are introduced, which were developed in the light of a number of themes which might be appropriate for inclusion in the forthcoming green paper.

These six areas are presented in detail in Chapters 3-8.

- Chapter 3 considers the principles which may govern the spectrum management and planning procedures in member states, in relation to potential policy goals for liberalisation and flexibility in the mobile services market.
- Chapter 4 covers the framework of coordination mechanisms for achieving well-considered frequency harmonisation to enable the introduction and cohesive availability on a pan-European basis of advanced mobile communications systems.
- Chapter 5 addresses frequency management methods which are likely to contribute to spectrum availability and effective use, to facilitate a dynamic and developing mobile communications market in support of potential overall policy goals.
- Chapter 6 examines particular aspects of coordination in support of spectrum planning for mass-market mobile communications and future generation systems in Europe.
- Chapter 7 considers the role of spectrum availability for subscriber access systems in ensuring market exploitation of potential further liberalisation of fixed telephony services and infrastructure provision.
- Chapter 8 examines frequency issues which would arise for the operation of multinational network infrastructures, potentially enabled through policies for further liberalisation and flexibility in the mobile communications sector.
- Appendix I, which is bound separately to this report, presents information which has been gathered on the areas identified for a common approach to spectrum management.
- Appendix II, which is bound with this report, contains a Glossary of terms and a list of Abbreviations.
- Appendix III, which is bound with this report, contains a Bibliography of source material referenced.

1.4 Acknowledgments

8 The study team would like to thank all the organisations that were contacted during the course of the study. We would also like to thank Dr Ungerer, Mr Toscano, Mr Eden and members of DGXIII for their comments.

2 Spectrum management context

9 This chapter presents a short overview of the international and European institutional environment for spectrum management and of EC telecommunications policy and spectrum policy goals. It then introduces the six areas identified for a common approach to spectrum management which are explored in chapters 3 to 8 of this report.

2.1 International spectrum management: Institutional environment

10 The international regulation of the radio spectrum is conducted through the International Telecommunication Union (ITU), which currently has around 170 member nations. The basic instrument of the ITU is the International Telecommunication Convention, which has international treaty status when ratified. Regulations and plans for spectrum allocation and usage, known as the ITU Radio Regulations, are agreed through regular World Administrative Radio Conferences (WARC).

11 Ratification by individual countries is on a voluntary basis, which is acknowledged in the ITU Constitution by the phrase "While fully recognising the sovereign right of each State to regulate its telecommunication...". While observance of these regulations is voluntary, it is generally within national interests to comply with international patterns, particularly to avoid the problems caused by creation of international interference.

12 The radio spectrum is divided into bands which have been allocated to several defined classes of services. This is set forth as a Table of Allocations (Article 8 of the Radio Regulations). The allocation of frequencies may be uniform worldwide or may vary according to the ITU region. For radio regulatory purposes, the ITU divides the world into three regions:

- Region 1 consists of Europe, Africa, the former USSR and Mongolia;
- Region 2 the Americas;
- Region 3 the remainder of Asia and Oceania.

13 The practice of allocation of frequencies to different services on an equal primary basis, the provision of differing allocations across regions and the possibility of national allocations through footnotes create flexibility in deciding frequency usage within national borders. Thus many international allocations are permissive rather than prescriptive. National administrations prepare frequency allocation tables which are based on those of the ITU and which are optimised to meet their national requirements.

14 Historically, the ITU membership consisted of national administrations which represented both operational and regulatory aspects of telecommunications. This situation is, to a large extent, changing through the increasing separation between operational and regulatory aspects. Thus, the ITU's membership is increasingly tending to exclude national operators and, accordingly, leading to a greater distance between the formulation of policy and its implementation.

15 In 1989 the ITU set up a High Level Committee (HLC) to consider the future of the ITU in the light of widespread concern that the ITU's regulatory provisions and procedures were complex and time consuming. The HLC recommendations, which were accepted by the ITU to come into effect in March 1993, recommended reorganisation of the ITU's functions into three separate areas of standards, radiocommunications and development.

16 A Voluntary Group of Experts (VGE) is studying allocation, improved use of the spectrum and simplification of the Radio Regulations. It is also examining alternative ways of allocating spectrum. One finding of the VGE has been that the Table of Allocations would be greatly improved if there were greater commonality across the three world regions and if the number of footnotes (which often provide exceptions to the Table) could be reduced.

17 Despite the major structural changes already undertaken by the ITU, some observers feel that not enough account has been taken of the degree to which their membership is becoming distanced from operational aspects of telecommunications. Additionally, there is a view that the ITU should focus solely on strategic issues of worldwide importance and should increasingly devolve responsibility towards regional bodies for policies and standards. There is currently no evidence that the ITU is considering this approach.

18 Appendix I, section 2.1.1 presents further information on this topic.

2.2 European spectrum management: Institutional environment

19 The European Conference of Postal and Telecommunications Administrations (CEPT) is the regional telecommunications organisation for Europe, and at 1 July 1993 was made up of 37 member countries from eastern and western Europe. In preparation for the WARC 92, CEPT administrations developed a common European view on a range of frequency issues (European Common Proposals).

20 CEPT membership was originally drawn from the national radio regulatory bodies and national telecommunications operators. The structure and membership of CEPT has recently been greatly revised to take account of the increasing separation in Europe between regulatory and operational telecommunications functions. Beginning from September 1992, membership is now made up solely of national regulators. Previous member operators formed their own body, the European public Telecommunications Network Operators' association (ETNO) in May 1992.

21 Until recently CEPT was also responsible for the development of standards and their implementation through CEPT member operators. With the encouragement of the CEC, responsibility for standards development was devolved to the European Telecommunications Standard Institute (ETSI) in 1989, including standards which were then in process of development under CEPT. ETSI, which was formed to accelerate standardisation and promote harmonisation among European telecommunications systems, now undertakes the technical standards-writing activities previously carried out by CEPT.

22 Under CEPT's new structure, a Plenary Assembly and three new Committees have been formed, each of which are responsible for sponsoring greater harmonisation of European practice within their areas of responsibility. These are the European Committee on Postal Regulations (CERP) with a membership of postal administrations, the European Committee for Telecommunications Regulatory Affairs (ECTRA) made up of national telecommunications regulators and the European Radiocommunications Committee (ERC), made up of national radiocommunications regulators. Each of these committees is supported by a number of working groups and project teams.

23 The ERC is supported by the ERO, opened in May 1991, which is a permanent organ of CEPT and which provides a centre of expertise, acting as a focal point for consultations on spectrum management and radio regulatory matters. The ERC is responsible for administrative radio regulatory and spectrum matters. Under its terms of reference, the ERC develops radiocommunications policies, develops guidelines in preparation for ITU conferences, plays a coordinating role in frequency, regulatory and technical matters and establishes and applies criteria for consultation with operators, users, manufacturers, standards bodies and other interested parties.

24 Since its inception the ERO has been deeply involved in carrying out a Detailed Spectrum Investigation (DSI) of usage of the radio spectrum in Europe. The overall objective is to support the development of a common European Table of Frequency Allocations to be implemented by June 2008, to ensure that European radiocommunications administrations,

industry, broadcasters, service providers, operators and users derive maximum benefit from the spectrum. It is envisaged that the common European Table of Frequency Allocations will provide the basis for proposals for improved spectrum management. In carrying out its DSI work, the ERC has co-opted assistance from the European Telecommunications and Professional Electronic Industry (ECTEL). The First Phase of the DSI (range 3400 MHz to 105GHz) was completed in March 1993, with public consultation on the results to be completed by June 1993. The Second Phase, covering 29.7MHz to 960MHz was launched in March 1993 and is intended to be completed by January 1995.

25 At its October 1992 conference in Madrid the ERC introduced a number of proposals designed to harmonise frequency allocations and regulatory mechanisms for radio-based voice and data networks. The most far-reaching proposal was for the introduction of firm agreements ("Decisions") by members to implement policies. CEPT recommendations have in the past been criticised for their relative weakness, since administrations need not be bound by them. Decisions are accordingly considered to be much stronger than Recommendations since administrations commit themselves, in writing, to implement Decisions. At this early stage it is not yet clear how successful such Decisions will be since, unlike EC Directives, there is no clear means by which CEPT can compel defaulting administrations to implement agreed Decisions.

26 Discussions have been going on for some time between the CEC and CEPT and a Memorandum of Understanding between the ERC and the CEC is in preparation, which is expected to further clarify the roles of each organisation in this area.

27 Contacts between the ERC and other intergovernmental organisations often occur on the basis of the participation of experts within national delegations which are taking part in the work of intergovernmental organisations. There are, however, several cases where Memoranda of Understanding have been entered into between the ERC and such organisations. These include the CEC, the European Free Trade Association (EFTA) and ETSI. These are being followed up by additional Memoranda of Understanding which will include and formalise a mechanism for regular direct coordination on telecommunications matters.

28 In Spring 1993, the ECTRA committee of CEPT also determined to establish a permanent support office (possibly to become known as the European Telecoms Office - ETO) and to institute a mechanism for ECTRA Decisions similar to that for ERO Decisions. A working group has been established to propose detailed arrangements for the ETO.

29 Appendix I, section 2.1.2 presents further information on this topic.

2.3 EC telecommunications policy

30 EC policy in telecommunications, supported by the CEC, is directed principally towards the introduction of a single market for 1993 and beyond, in which competitive supply opportunities exist for the majority of services and products, and technical harmonisation ensures maximum compatibility and interoperability of telecommunications throughout the EC. Emphasis is also placed on liberal and harmonised regulation to ensure fair market competition with minimum restrictions on telecommunications users and their applications. Additional policy objectives include the promotion and harmonisation of advanced services across the EC.

31 The main influence on telecommunications regulation stems from the CEC's 1987 green paper ("Towards a Dynamic Economy - Green Paper on the Development of the Common Market for Telecommunications Services and Equipment"); this identified the regulatory changes necessary to facilitate a single EC-wide market by the end of 1992, founded on an open and competitive environment.

32 The green paper did not specifically address mobile services, but it was planned that the

CEC develop a coordinated coherent policy for the development of all mobile telecommunications networks and services within the EC. In advance of that policy, mobile services have been the subject of individual decisions within EC telecommunications policy, notably on the introduction of pan-European services for mobile telephony (GSM), paging (ERMES) and cordless telecommunications (DECT). The CEC, reinforcing the work of CEPT, also played a significant role in recent initiatives towards the introduction of Terrestrial Flight Telecommunications Systems (TFTS) and of Digital Short Range Radio (DSRR) in the EC.

33 Following from the 1987 Green Paper, the CEC's Directive on competition in the markets for telecommunications services (Directive 90/388/EEC - "the Services Directive") and the associated framework Directive on Open Network Provision (Directive 90/387/EEC), identified mobile services as an area for which ONP conditions could be drawn up and a study has been carried out for the CEC, which was completed December 1992, on the application of ONP to Mobile Telephony, Data Networks and Paging Services.

34 Currently, the CEC are developing a green paper on Mobile Communications, which is planned to be published later this year. The results of this study, and of two parallel studies on "Analysis of Current Licensing and Declaration Procedures" and "Future Trends in Technical Development and Commercial Provision" are intended to support the CEC in developing this forthcoming policy paper.

2.4 EC spectrum policy goals

35 The EC Council passed a Resolution in June 1990 (Resolution 90/C166/02) recognising the importance of strengthening of European-wide cooperation on radio frequencies, in particular with regard to services with a pan-European dimension. In the Resolution the Council recognised that a coordinated approach to frequency allocation for Europe-wide systems is being developed within the framework of CEPT. The Council identified five major policy goals in the area of frequency allocation:

- (1) strengthening European cooperation in the field of radio frequency coordination, with the objective of providing for a sufficient frequency spectrum for new services;
- (2) working towards the timely allocation of sufficient frequency resources to mobile and satellite applications;
- (3) promoting the most efficient use of the frequency spectrum;
- (4) developing common European positions in relation to the use of the frequency spectrum, in particular with regard to the ITU and its relevant administrative radio conferences, using mechanisms set up by CEPT;
- (5) to support these objectives, encouraging the further development of the framework of cooperation between frequency experts from national authorities responsible for frequency management, telecommunications organisations and other service providers, industry and users, developing the existing coordination mechanisms set up by CEPT.

36 In the Resolution, the Council invited the CEC, the Member States and CEPT to support the further development of the new framework set up by CEPT, including the setting up of the ERO.

37 There has been criticism, notably from some members of the CEPT committee, ERC, of the approach to frequency reservation in CEC Directives relating to pan-European services such as GSM. Similarly, there has been concern within the CEC that ERC's recommendations on frequency issues have no legal basis, although these have recently been strengthened by an

agreement to establish binding policy accords through Decisions, as noted above.

38 A Memorandum of Understanding between the ERC and the CEC is in preparation, which is expected to set out arrangements for cooperation and procedures for the CEC to mandate the ERO to conduct work of a technical nature.

39 It is also expected that the green paper currently being prepared by the CEC will contain proposed positions of the CEC on frequency management. This study is intended to support the CEC in developing such proposed positions.

2.5 Forthcoming EC Mobile Communications green paper: Areas for a common approach in spectrum management

40 The study has aimed to identify common approaches in the field of spectrum management which the CEC might propose as part of the forward EC policy for mobile communications and related matters which, as noted above, is expected to be developed in the forthcoming green paper.

41 At an early stage in the study a number of likely beneficial areas for such common approaches were established and agreed as the focus for subsequent study and elaboration.

42 Areas for study were developed in the light of a number of themes which might be appropriate for inclusion in the forthcoming green paper. Established EC telecommunications policies, promoting the cohesive availability of advanced services in the EC and a single market for telecommunications equipment through harmonisation on a pan-European basis, are expected to continue for the mobile communications sector, together with encouragement of the effective use of basic resources such as the radio frequency spectrum (and network-numbering space). Further policy goals towards optimal development of the mobile communications sector which may be appropriate for inclusion in the green paper would be:

- Progression to full liberalisation of the mobile services market, with competition in network operation, and a vertical market structure for service provision.
- Maximum flexibility for inter-supplier relationships, particularly in support of interconnection and access arrangements amongst competing suppliers.
- Operational flexibility across the telecommunications sector, allowing advantage to be taken of further liberalisation for fixed networks and services.
- Support for development of personal communications services in the EC.

43 Against this background, the following aspects of spectrum management were chosen as the context for developing proposals for EC positions (and lines of action) in the field of mobile telecommunications and spectrum management.

- Open procedures for frequency management: - considers the principles which may govern the spectrum management and planning procedures in member states, in relation to potential green paper policy goals for liberalisation and flexibility in the mobile services market.
- Frequency harmonisation for pan-European services: - covers the framework of coordination mechanisms for achieving well-considered frequency harmonisation, to enable the introduction and cohesive availability, on a pan-European basis, of advanced mobile communications systems, in implementation of EC policies for the telecommunications sector.

- **Effective usage of spectrum resources:** - addresses frequency management methods which are likely to contribute to spectrum availability and effective use, to facilitate a dynamic and developing mobile communications market in support of potential overall policy goals of the green paper.
- **Spectrum issues for emerging services for personal communications:** - examines particular aspects of coordination in support of spectrum planning for mass-market mobile communications and future generation systems in Europe.
- **Infrastructure for competing fixed-networks:** - considers the role of spectrum availability for subscriber access systems in ensuring market exploitation of potential further liberalisation of fixed telephony services and infrastructure provision.
- **Frequencies for cross-border network operations:** - examines frequency issues which would arise for the operation of multi-national network infrastructures, potentially enabled through policies for further liberalisation and flexibility in the mobile communications sector.

44 Each area is elaborated in a following chapter, with further background material presented in Appendix I.

3 Open procedures for frequency management

45 Traditionally, the spectrum management process has been carried out by NRAs as a closed process without the involvement and representation of the opinions of the wider public. This situation is beginning to change, and there is evidence of increasing acceptance of the principles of public involvement in the spectrum management decision process.

46 This chapter reviews options for embodying open and objective principles into national procedures for allocation practice, selection of operators and operator expansion planning.

47 Further background material concerning this topic is contained in Appendix I, in section 2.2.

Openness of procedures: public consultation

48 Major users, such as Government, the military and public service telecommunications and broadcasting organisations, have generally always had a voice in spectrum management through their representation on national frequency committees. Such committees meet on a regular basis to consider issues such as site clearance and possible conflicts/interference of other proposed frequency assignments on existing assignments. The proceedings of these committees are not in the public domain.

49 Until recently, in most member states, no official platform existed to take account of the views of smaller users, such as private mobile radio (PMR) users, who together make up a significant proportion of licensees.

50 This situation is now changing with a number of member states beginning to open up some spectrum management activities to take account of public opinion. So far these changes have focused upon:

- the setting up of consultative committees which focus on particular service aspects such as broadcast or land mobile and whose membership is representative of that service community (eg manufacturers, dealers, network operators, users). These committees are intended to offer a platform for the user community to put forward their views;
- when the introduction of new services (or the re-planning of existing bands) is under consideration: the encouragement of public debate, the setting up of consultative committees and the publication of consultative documents on the issues of service allocation and operator licensing.

Openness of procedures: allocation practice

51 A number of member states publish a national table of allocations, modelled on Article 8 of the ITU radio regulations, which includes details of frequency allocations to specific categories of service. Many member states also publish details of new allocation decisions, often in the national Official Gazette.

52 Despite the recent development of vehicles for consultation of interested parties, set out above, there is usually no uniform approach within a given nation to procedures which lead to allocation decisions. Currently only Germany has set up an open and standard procedure for civil frequency allocation decisions, which indicates the detailed consultative steps to be taken.

53 Decisions made at the initial allocation stage as to the amount (and characteristics) of spectrum to be allocated to a given service will implicitly or explicitly include a set of assumptions and constraints which will continue to affect the development potential of that service throughout its lifetime. These constraints will include:

- the number of operators that will be practically possible within that service allocation;
- the degree of planned expansion which will be possible.

54 Accordingly, it is important, particularly in the case of services to be offered commercially, that the decision process followed by the NRA is seen to be fair and equitable, and to take due account of the development potential of that service.

Proposed Position

Member states should embody open and objective principles in national procedures for spectrum allocation and usage planning (including those for determination of maximum operator numbers in a band).

Openness of procedures: selection of operators

55 In general, member states have to exercise some control on the range of possible applicants for frequency capacity for particular types of mobile service. The industrial policy which is being followed in particular member states may reflect assessments of viable market dynamics for certain services, and the progress of selected technology developments. This, coupled with the ability to make a relevant extent of spectrum resource available (and to support a degree of duplicated infrastructure provision) may condition the maximum number of rival network operators for which use of the spectrum is planned.

56 Member states will wish to restrict the eligibility of potential applicants for frequency spectrum to those properly authorised to offer an associated service. Some member states, currently combine procedures for authorisation of frequencies for operation of a network infrastructure with the authorisation of services on the network. In assigning frequencies (particularly for public infrastructure operation), member states may wish to limit authorised operators to those with a significant EC-based ownership.

57 Current assignment methods in member states differ, and in some circumstances may not attempt equal access to frequencies for potential rival operators. Some regulators argue that it is appropriate for an operator with a statutory public service role to be granted use of frequencies on a first-come basis, while direct competitors must follow some different tendering procedure. This was the case for GSM licensing in Denmark and Germany, where the incumbent public operator was directly awarded a licence while prospective competitors participated in an invitation to tender procedure, described below. In many cases, potential authorisation for use of additional frequencies in a service band (eg for cellular mobile) will be limited to already established operators who can show justification for an expanded assignment - in accordance with a usage plan established for that service.

58 Methods used for granting of licences tend to vary according to the type of service. The most usual method is on the first-come first-served principle, which is common for services such as PMR which are not commercially offered to third parties. Increasingly, where it is intended to license only a small number of competing operators, the public tender process is often chosen. This involves a public call for applications from potential licensees. The applications are then evaluated, often by a panel of experts, through the application of objective (although not always public) selection criteria.

59 The criteria used to evaluate applications, consisting of business and technical plans, are likely to include:

- soundness of financial backing;
- technical approach;
- marketing approach;

- overall quality of proposed service.

60 In general, there are no formal mechanisms for unsuccessful licence applicants to appeal, other than through court appeals procedures which apply generally to government actions.

Proposed Position

For assignment of frequencies to operators, member states should adopt open and objective procedures which, for a given usage, ensure equality of opportunity for potential operators (except in objectively justified cases).

Openness of procedures: operator expansion planning

61 As noted earlier in this chapter, decisions made at the initial allocation stage as to the amount (and characteristics) of spectrum to be allocated to a given service will implicitly or explicitly include a set of assumptions and constraints which will continue to affect the development potential of that service throughout its lifetime. These constraints will include:

- the number of operators that will be practically possible within that service allocation;
- the degree of planned expansion which will be possible.

62 Where a frequency band is to be shared by several competing operators of a given service, consideration also needs to be given to long term effective and equitable use of the service band, as well as to initial frequency assignments. Although the operation of multiple networks may well impact the ultimate overheads and technical efficiency with which frequencies in the band could theoretically be employed, commercial pressures of service competition are expected to force more effective use in practice.

63 The process of frequency planning for a given competitive service has the drawback that the planning process may to a large extent have been completed by the time the service has been introduced. If the entire band is assigned long-term in equal shares from the outset, competitors will have a stable base for commercial planning. However, options may have been lost for the introduction of further players, or to provide resources differentially as competing networks are more or less successful and expand or contract. This means that if the market develops differently (either more or less successfully) from the way on which the original planning was based, there may be insufficient flexibility for the NRA to respond quickly to market changes.

64 This problem may become more acute where a number of differing mobile and fixed services are sharing a frequency band, imposing a further range of constraints and uncertainties to be considered by the spectrum manager in planning for possible operator expansion.

65 The approach taken by several member states, including France and Germany, to the release of frequencies to commercial operators, as discussed in chapter 5, is that of the phased release of frequencies. While the operator, through the terms of its licence, has the assurance of an agreed frequency assignment, only an initial tranche is assigned in the first instance. Before new frequencies are released, the operator has to satisfy the NRA that current frequencies are being effectively exploited.

66 This phased approach to frequency release is of benefit for both the long-term management of the service band and the medium to longer-term operator planning process. It incorporates a greater element of flexibility, allowing the NRA to respond to changes in market development.

Proposed Position

Member states should, when planning for frequency usage in commercially offered mobile services, make due provision for competing multiple infrastructure operators.

Proposed action for CEC

- **The CEC should prepare a recommendation (or other appropriate measure) to introduce guidelines for NRAs in member states on incorporation of open and objective principles in their frequency management procedures, and to enable the periodic review of these procedures by the CEC in the light of effective availability of spectrum for new services and the progress of competitive service provision in the Community.**

4 Frequency harmonisation for pan-European services

67 As a significant element in its policies for the Telecommunications sector, the EC has promoted the introduction of particular harmonised services and systems on a pan-European basis. This approach, which can be expected to continue, has been applied to fixed services such as the ISDN, and to mobile services and systems including, amongst others, the GSM system for digital cellular mobile telephony. For radio based systems, it is clear that the EC must seek to ensure that common frequencies are identified and made available in a timely manner to support the considerable investments by the EC and by industry in research, standards definition, and the development and cohesive implementation of products and networks for such pan-European services.

68 In this chapter, appropriate mechanisms for achieving an appropriate harmonisation of frequency usage and availability in the EC are examined. Further background material concerning this topic is contained in Appendix I, particularly in section 2.3.

Contribution of pan-European frequency harmonisation

69 Regional harmonisation of frequencies for particular services or systems can serve a number of aims, whose benefits are widely recognised and accepted amongst regulators and the industry.

70 Firstly, the designation of a common frequency band (or bands) to be allocated by countries in the region for use by the particular system identifies the spectrum range for equipment standards specification, and for operation - thus enabling a large common market for systems and terminals, with economies of scale for industry and users; furthermore, international roaming capabilities are supported for users in relevant services.

71 Secondly, the harmonisation of time-scales for availability of the common frequencies for authorised operations throughout the region presents the assurance that the service and markets can be realised on a coherent pan-European basis. These time-scales may also signal requirements in individual countries for programmes to clear spectrum bands of existing frequency users in order to release newly allocated service frequencies.

72 A further outcome of frequency harmonisation for particular services is that compatible planning of spectrum use at national borders will generally improve the basis for cooperation in managing cross-border interference or other operational issues.

Cooperation through CEPT

73 Both the industrial market for telecommunications systems and the operational environment for services and networks in Europe extend beyond the current member states of the EC - to countries which are contemplating joining the EC and more generally through bordering relationships with all the surrounding states in the European region.

74 Thus national regulatory administrations and the supply industry (both for equipment and for networks and services) are all anxious that consistent harmonisation agreements and commitments are developed, not just for the EC, but within a wide European and world market context.

75 For this reason, CEPT is seen as a prime environment for establishing pan-European consensus on frequency harmonisation. At 1st July 1993, some 37 national administrations (as regulatory bodies) were represented in CEPT and its committees, ECTRA and ERC. CEPT membership includes all the member states of the EC and those of the EEA, as well as extensive further representation of the Nordic, Eastern European and Mediterranean countries. Section 2.2 of this report gives more detailed information on the structure and activities of CEPT.

76 The CEC collaborates closely with CEPT and a Memorandum of Understanding is in preparation to establish the relationship between the CEC and the ERO, which is a permanent centre of expertise of the ERC.

77 For frequency harmonisation, the basis for common usage allocations of the spectrum is the Radio Regulations of the ITU, containing the International Table of Frequency Allocations (developed through world and regional administrative radio conferences, such as the WARC-92 conference) - which all member states of the ITU respect in their national planning of spectrum use. The international table, besides allowing considerable flexibility for alternative usage or sharing in national allocations, is fundamentally based on generic service classes (showing generic band allocations for terrestrial broadcast service or for the land-mobile service, rather than for any more particular use - such as for private mobile radio - or particular system - such as GSM cellular public networks). However, as an exception, the WARC-92 did designate frequencies for use in FPLMTS (future public land mobile telecommunications systems).

78 The range of permitted options, coupled with historically established spectrum use, has led to considerable diversity in current national tables of frequency allocation. This basic diversity in planned use of the spectrum makes for difficulties in establishing agreement on common frequency bands for pan-European harmonisation in particular cases. With a view to rationalising this situation in the long term, CEPT (through the ERC/ERO) is developing proposals for a Common European Table of Allocations intended to harmonise planned usage for all radio-based services throughout the spectrum on a pan-European basis by a target date of 2008. These proposals would be put into effect by the adoption of CEPT Recommendations and Decisions.

79 To establish proposals for an eventual Common European Table of Allocations, the ERO has initiated a series of DSIs to cover ranges of the overall spectrum. DSIs will document existing practice for allocation and spectrum usage, examine potential requirements for new and evolving services, and propose how these might be accommodated and consolidated in a common plan for CEPT countries. The report of the first DSI (examining the range 3GHz - 105GHz) was released by the ERC in March 1993 for comments; it proposes a target plan for common allocation by 2008, together with recommended practices in spectrum responsibility and preparatory actions from 1998.

80 A second DSI (for the range 30 MHz - 960 MHz) has been initiated, aiming to present proposals in early 1995. These investigations incorporate an extensive phase of open consultation with industry and other interested parties (which is also a general function of the ERO); the team for the main analysis phase of the first DSI included a representative of the equipment industry (through ECTEL) as well as ERO personnel representing regulatory administrations.

Proposed position

The CEC and member states should encourage and support work through CEPT towards establishing in the long-term a common European table of frequency allocations.

81 The first DSI considered use of frequencies above 3GHz, and thus not of prime interest in providing telecommunications services to mobile users. The current DSI, examining use of frequencies below 1 GHz, will present a major opportunity for in depth collation and review of national spectrum usage in Europe and the potential for harmonisation of spectrum allocation for many current mobile services which occupy this range - both for public mobile telephony and for PMR systems to support professional users in company or public service groups. The

range 1GHz - 3GHz is expected to be covered by a subsequent DSI, and will be particularly significant in identifying requirements and harmonisation possibilities for emerging mobile services (including personal communications services for the mass market); some contributory studies for this range have already begun within the ERC/ERO.

82 The CEPT framework, with its coverage of both EC member states and the wider pan-European grouping of countries, is also appropriate for the development of frequency harmonisation agreements for particular mobile systems or services in the nearer term, to support the implementation of EC policies for the telecommunications sector.

Spectrum support for EC telecommunications policies

83 The EC needs to ensure that its policies for harmonised introduction of particular systems or services are supported by coordinated EC-wide action in spectrum management to make frequencies available for system operation in each member state. A variety of market situations are likely to exist in EC member states (which for mobile services may reflect in particular the expected maximum density of subscribers or users in the most populous parts of a country, as well as the extent of competition anticipated for supply of infrastructure networks). Therefore member states should be allowed sufficient flexibility to match their planned allocation of frequencies for a service with the foreseen market-related spectrum needs - to ease spectrum management options and avoid unnecessary disturbance of users established under pre-existing allocation plans.

84 The EC has always based its requirements on allocation agreements adopted within CEPT, encouraging their development in some cases. CEPT has a well-established process for developing and agreeing technical recommendations, including on harmonised spectrum allocations to be implemented in member countries. For example CEPT Recommendations have been adopted which designate common spectrum bands for all member countries for use in such radiocommunications systems as GSM (digital cellular telephony), DECT (cordless telephony), ERMES (digital paging), DSRR (short range radio), TETS (terrestrial flight telecomms); additional Recommendations identify common frequencies (but not harmonised pan-European provision) for TETRA (digital mobile trunked radio) and DCS1800 (digital cellular telephony).

85 Since CEPT Recommendations are not binding on member administrations, and in some cases an explicit time-schedule for frequency availability was not incorporated, the EC sought to ensure implementation in a number of cases through the adoption of Council Directives requiring that CEPT recommended frequencies were made available in all EC member states for use in the relevant harmonised services. Such directives were adopted between 1987 and 1991 for GSM, ERMES, and DECT systems.

86 In this process, some of the flexibility for national provision which was incorporated in the terms of the original CEPT recommendations was lost (particularly in the terms for minimum exclusive spectrum provision for the GSM system). Furthermore, application of EC legislative measures could strengthen the commitment to harmonised frequency availability only within EC member states - although both the telecommunications industry sector within the EC and regulators and industry in other European countries would welcome a similar assurance across the wider market region for many pan-European systems and services.

87 In response to this situation, in October 1992 CEPT agreed a process for ERC Decisions. Going beyond the Recommendation process of agreement, the ERC Decision process requests CEPT member administrations to commit themselves in writing, and on public record, to implementation of the Decision (whose terms may include a timeschedule).

88 Subsequently, ERC Decisions have been agreed on harmonised frequency bands for

TFTS, in the road transport telematics area, and for DSRR. For TFTS over 20 national administrations have committed to making the harmonised frequencies available (including all member states of the EC and EEA). For DSRR, in the period to July 1993, 19 CEPT member countries (including the member states Belgium, Denmark, France, Germany, Ireland, Netherlands, Portugal, Spain, and the UK) have indicated their commitment to the implementation of this Decision.

89 The ERC Decision process has established a multilateral approach to frequency harmonisation within the wider European context of CEPT, through which EC member state and other administrations accept binding commitments to common spectrum usage and availability of frequencies for authorised system operations. A CEC Council Resolution of November 1992 confirmed that ERC Decisions should be the primary method for achieving European frequency harmonisation. However, CEPT procedures do not provide for sanctions or enforcement should national commitment to an ERC Decision not be undertaken or fulfilled; in this context a CEC Communication to the Council is understood to be in preparation to clarify the conditions under which the CEC would refrain from making legislative proposals.

Proposed position

The CEPT ERC Decision process should be considered by the EC as the primary route to achieving harmonised frequency allocations, usage, and availability in Europe. The CEC should monitor and review the effectiveness of this process in achieving the requirements of telecommunications policies adopted by the EC; should adequate and timely harmonisation of frequencies not be achieved in member states in particular cases then the CEC should initiate appropriate EC legislative measures to ensure such harmonisation in the EC.

90 In general it appears that regulators are confident that existing approaches based on development of CEPT Recommendations and Decisions can identify harmonised frequency bands whilst allowing sufficient flexibility for varied national implementation circumstances. The designation method itself allows for selective availability of frequencies within the band and for some sharing with other services if appropriate. Furthermore, examples such as the recommended allocations for the GSM system show provision for varied bandwidth needs in different countries - with recommended contiguous common bands for initial service implementation and expanded provision (harmonised for all Europe) plus a further extension band common band (for national use should market needs justify this and requirements for military systems permit). This extension band is also designated in other Recommendations for other civil mobile networks (such as TETRA systems) - allowing national regulators to accommodate alternative patterns of market take-up amongst different mobile communications solutions.

Opportunities for improved outcomes in European frequency harmonisation

91 The continuing process of finding and releasing adequate frequencies for mobile services on a pan-European basis could be frustrated by direct pressures on the limited spectrum resource and more generally by weaknesses in the framework of collaboration and cooperation amongst the various institutions and groups contributing to pan-European frequency harmonisation. The EC could contribute to an improved framework for frequency harmonisation and planning.

Strategic EC market view

92 A number of regulators felt that EC policies for pan-European service implementation should stem more directly from identified market interest at national level and be placed in the context of a broad market development strategy agreed as a EC view. This should present a

more qualified market justification for harmonisation activities and service introduction and, by encompassing a range of services for voice, messaging, and data communications, provide guidance and priorities for individual technical and planning decisions. This guidance could be particularly appropriate, for example, in setting EC priorities for the allocation of the most economically exploitable frequencies amongst alternative uses, or for the incorporation of individual service features and capabilities into standardised systems (perhaps introducing overlap and potential competition with other service applications).

93 The ERMES paging service provides an example of where such strategic market guidance might have contributed to more robust policies; although the amount of harmonised spectrum required is relatively small, at least one member state had to institute a significant clearance and relocation programme for existing frequency users. The extent of demand for a new harmonised service with international roaming pager use is still seen as uncertain, as is the relationship between that roaming market and one which might be met through implementation of paging capabilities specified within the GSM system - for which a major harmonisation and pan-European implementation effort is being mounted.

94 There was concern amongst regulators and industry suppliers that the market potential for new radiocommunications systems and services should be analysed more thoroughly, together with the broad cost-benefits of service-provision options, in order to contribute to the rationale for pan-European harmonisation commitments. Much of the expertise in market and product economics lies within the equipment industry and network operators and a better harnessing of this capability would be valuable; this might be possible through more emphasis on market oriented contributions by industry within ETSI, through inputs via ECTEL and ETNO into the frequency harmonisation process and through the consultation mechanisms of the ERO.

Proposed position

Greater collaboration should be encouraged amongst the various groups contributing to the process of frequency harmonisation in Europe, in particular to incorporate expertise in market and implementation economics.

95 The cost implications of clearing incumbent users from common frequency bands newly harmonised for a particular service designation are a major concern for regulators and frequency managers. One of the factors for consideration in planning and time schedules for harmonised frequency use should be an assessment of cost elements in relocating (including retuning) or re-equipping the systems of existing users to release frequencies for the new harmonised service; approaches to funding such costs also need examination.

96 One factor in the market need for frequencies for any particular service will be the extent to which multiple operators are enabled to provide competing radio network infrastructures. Some competition at this level can be expected to be the norm within the EC for commercially provided services, although more extensive choice for users may be achieved through additional competing service providers based on shared use of radio access facilities. For trunking radio systems in general, there will be some loss of spectral efficiency where a similar number of users is served by several rather than one network system. This arises from the smaller resulting cell systems - with a poorer channel contention efficiency and a greater proportion of control channel overheads.

97 This aspect of EC competition policy must be recognised in spectrum planning, although it is believed that this has not been the case in some recent instances. For example, the bandwidth requirements calculated for TFTS (providing aeronautical passenger communications) in Europe and the spectrum needs estimated for FPLMTS (future personal communications systems) do not appear to have considered the effects of spectrum sharing by multiple operators serving the same territory. In these cases single-operator requirements have been carried forward into an ERC Decision on harmonised frequencies (for TFTS) and initial

long-term world-wide allocation indications (at WARC-92 for FPLMTS). The designated bands may have to be re-examined for European requirements to consider the implications of any less efficient spectrum use arising through competitive operations.

Proposed position

Prospective frequency harmonisation activities for telecommunications systems and services with potential for pan-European implementation should be supported through the development of common EC positions identifying (inter alia) the EC's strategic view on market prospects and associated spectrum requirements in relation to the relevant systems or services; the impacts of a competitive supply regime and of necessary band clearance programmes should be included in assessments of common spectrum requirements.

98 Thus a EC-wide policy on frequency management issues might be developed and agreed by all member states, to identify EC priorities for pan-European services and the economical and industrial basis supporting the policy.

Framework for technical coordination in harmonisation of radiocommunications

99 Such strategic views could provide a useful framework for better technical conclusions in pan-European harmonisation, particularly if coupled with a more effective arrangement for coordination between the specification of standardised systems and the choice of common spectrum location (with its adjacent bands and services). A number of recently harmonised systems have shown indications that insufficient attention was directed at adjacent service or system impacts - examples include potential constraints on the usability of the DSRR band channels in the presence of adjacent GSM channel operations; potential incompatibilities between DECT operations and DCS1800 systems at the boundary between their adjacent designated bands; and problems in coordinating ERMES base station operations with existing spectrum uses.

100 The performance limit specifications for radio systems clearly impact both product costs and potential for adjacent band interference. At present there does not appear to be a codification of responsibilities between technical standards bodies (in particular ETSI) and spectrum planning fora (such as ERC) to address performance requirements on a newly standardised system in relation to the actual common frequency band(s) designated for it - and its coexistence with adjacent band systems and services (both existing and planned). This could form an important part of a formal coordination process between ETSI and the ERC, which at present cooperate informally in considering channel arrangements and standards for radiocommunications systems.

Proposed position

To ensure that the full benefits of newly introduced mobile systems are realised in practice in the EC, it is vital that radio performance characteristics and operational frequencies are chosen and matched after a thorough assessment of impacts both for the new system and on existing or planned users in adjacent frequency bands. To this end, technical liaison between ETSI and the ERC on radio-frequency related matters should be ensured through a formal framework for cooperation between these bodies. The EC should encourage and assist in the achievement of such cooperation.

Coordination of civil and military spectrum planning

101 It is estimated that over 30% of the spectrum range 30MHz - 960MHz, in which mobile

systems at present mainly operate, is typically allocated in European countries for Governmental (and chiefly military) use - approximately twice the bandwidth allocated for land mobile services. A high proportion of the range to 3GHz is also currently allocated for military communications (for example in the UK almost 25% for exclusively military applications with a similar proportion shared between military and civil use). There is a trend to frequencies around 2GHz for future public mobile service systems with extended market potential for personal communications (such as DECT, DCS1800, and FPLMTS).

102 Opportunities for release and re-use of lower frequencies exist (eg through phasing out of early public mobile systems, or encouragement of trunked systems for PMR applications) but these are limited. The availability of frequency bands for common allocation to new systems or services is likely to remain problematic. Although not primarily a candidate for pan-European roaming service implementation, recent frequency harmonisation for TETRA (digital trunked mobile radio) failed to identify a common pan-European band - rather, four alternative bands were identified to accommodate viable national allocation options and to establish spectrum parameters for the equipment industry.

103 On the other hand there is an emerging willingness to consider more widespread scope for sharing spectrum between civil and military use (or even release of spectrum from military use). The common bands identified for TETRA include one which is currently reserved exclusively for military use in North Atlantic Treaty Organisation (NATO) countries (and another which is allocated for defence use in a number of member states) - the civil availability of these frequencies has yet to be agreed. Availability of the GSM harmonised frequency band required negotiated release of frequencies by existing military users in many European countries, and in the UK and France public mobile networks (for voice or data) are sharing frequencies geographically with the military - allowing use for civilian services in the populous capital city areas.

104 The significant proportion of spectrum used for defence communications is a major factor in the difficulty in identifying common frequency bands for new civil systems, and there would be significant benefits from an improved dialogue with military spectrum planners to ensure that advantage can be taken of any further opportunities for release or sharing of spectrum which has previously been planned for exclusive military use.

105 Open fora for discussion of civil-military spectrum issues are under consideration in countries such as Germany and Spain, and countries such as Germany and the UK have a strong record of close collaboration between the civil and military spectrum planners. The ERC/ERO is fostering relations with NATO's Allied Radio Frequency Agency (ARFA). ARFA anticipates a major revision to the NATO Joint Frequency Agreement over the next two years (at least for allocations up to 3GHz); this Agreement forms the basis for support by national regulatory administrations for military frequency requirements in Europe, and ARFA plans to conduct the revision through a process of joint civil/military meetings.

106 The EC could play a useful role in fostering civil-military collaboration for national spectrum management, in promoting EC policy on frequency management issues to NATO spectrum planners, and encouraging more open exchange and accessibility of non-sensitive information on current spectrum usage in Europe.

Proposed position

Member states should strengthen civil-military cooperation on spectrum planning, supported by the CEC in particular for planning on a pan-European basis and cooperation with NATO.

107 In many European countries (and elsewhere in the world) significant parts of the spectrum are not directly managed by the national regulatory administration for civil

radiocommunications (or even under its delegated control) - this commonly applies to spectrum allocated for military use, but may also apply to spectrum blocks for use by other Government Departments (particularly with police or security responsibilities), for use in broadcasting services, and possibly in other cases. When national regulators consider frequency harmonisation proposals in fora such as CEPT it is clearly desirable that authoritative national positions can be represented over the spectrum as a whole (based on appropriate national preparatory discussions with other relevant agencies) - so that progress towards consensus on common frequency possibilities can be as rapid as possible.

108 Despite more sympathetic civil-military cooperation on frequency planning, it is likely to prove increasingly difficult to identify single contiguous frequency bands for harmonised designation on a pan-European basis. The example of TETRA alternative common bands has already been cited. Designation of the DCS1800 band to support cellular telephony in markets which cannot be sustained within the GSM harmonised frequencies is a somewhat similar case, and the DECT allocation for cordless telephone systems could only be expanded by non-contiguous extension bands should this prove a requirement in future, since direct expansion of the band is effectively blocked by provisions for DCS1800 and the FPLMTS systems.

109 Specification of future systems with agility to operate in a range of frequency bands (and intelligence to recognise frequency and interface requirements in varied operations) might offer to cope with such multiple-band service allocations and allow considerable implementation freedom within a basic harmonisation framework. However, current indications are that there can be significant cost penalties for multi-band terminal equipment, and the importance of specifications to avoid adjacent band interference effects would become even more significant for such systems.

Proposed actions for the CEC

- **The CEC should complete as rapidly as possible, Memoranda of Understanding with the CEPT committees ERC and ECTRA, and framework agreements with their permanent offices ERO/ETO.**
- **To follow up the Council Resolution of 19 November 1992, the CEC should propose a further resolution elaborating the basis on which EC objectives for frequency harmonisation are anticipated to be achieved primarily through ERC Decisions.**
- **The CEC should sponsor studies of strategic market prospects and associated spectrum needs as appropriate for mobile systems with pan-European characteristics, where relevant through work requirements to ERO/ETO; the CEC should encourage extensive industry consultation and participation in this work.**
- **The CEC should consider development of a formal relationship with NATO (through the ARFA) to examine European spectrum issues.**

5 Effective usage of spectrum resources

110 Demand for radio spectrum generally exceeds supply, particularly for frequencies well-suited to communications services for mobile users. Established sharing of such bands by other users (both civilian users for non-mobile applications and military users) contributes to the shortage. NRAs are faced with the problem that spectrum in the VHF/UHF bands is, in the main, fully allocated, giving rise to difficulties in accommodating expanded services and introducing new services.

111 Development of the mobile communications market - through new services, technologies and competitive structures, more universal penetration and continuing opportunities for private networks - will require the availability of increasing amounts of spectrum in frequency bands technically suited to mobile operations. At the same time, demands for spectrum for other service applications and non-civil uses are changing and must also be recognised.

112 This chapter is in three sections. Section 5.1 outlines the major assignment methods used by national spectrum managers and section 5.2 provides a discussion of market price mechanisms. These two sections provide background information for section 5.3, on current approaches to spectrum management, which examines some possible options for increasing spectrum availability, together with a number of economic and technical options for increasing the effective usage of spectrum resources.

113 Further background material concerning this topic is contained in Appendix I, in section 2.6.

5.1 Assignment methods

114 The methods used by national spectrum managers in assigning spectrum will vary in line with both the type of service (eg PMR or public cellular telephony) and the role for technical or economic factors which has been adopted by the NRA. Several possible economic approaches, including administrative cost-covering, administrative price-oriented fees and market-based pricing are discussed later in this chapter.

115 In many cases the assignment of frequency usage rights is combined with operator licensing for network and service provision.

116 This section gives an outline of the major assignment methods which are in use or under consideration by various national administrations, in order to support the later discussion of economic approaches. The major assignment methods outlined below are as follows:

- "First come, first served" method;
- Administrative comparative method;
- Lottery method;
- Auction methods.

Assignment methods: "First come, first served" approach

117 The first come, first served approach is the most widespread, longstanding approach. It is used in cases where, most often, the spectrum resource being assigned will allow a large number of users to be accommodated over time, and the users are not commercial operators directly competing in the same service. Users will need to meet qualifying criteria set down by the regulating authority (eg for PMR, the use of type approved equipment, for a given frequency range, tested in situ before issuing of licence), but these will apply across the board to all applicants.

118 All potential users can apply for frequencies for a given application, such as for PMR or for fixed links and, provided that they meet the qualifying criteria and frequencies are available for the proposed channels, they will be assigned appropriate frequencies. Fees charged by the regulating authority will generally be on a cost-covering basis, which aim to reflect the cost to the regulator of administering the process (together with any activities in usage monitoring or research into spectrum management).

119 Frequencies assigned in this way are on a non-transferable basis, for a specified use and licences are renewable on an annual basis on payment of the annual fee. There is generally a clause in these licences which authorises the regulator to withdraw the licensed frequencies at any time. This clause allows the regulator to plan to meet any international commitments that may arise (for example through international and bordering country frequency coordination or, in the case of member states, for pan-European services). However, NRAs rarely withdraw such licences at short notice, and aim to give 5-7 years notice to users of any proposed withdrawal. Any shorter notice raises a migration problem for users who have not yet recouped their investment in equipment.

120 The first come first served approach is, however, only workable where the resource being licensed is not scarce, and where applicants can be granted frequencies within a reasonable amount of time. PMR frequencies, in particular, are coming under great strain in many major cities, leading to closing of waiting lists and sharing of frequencies (using different call signs) between different users. In such cases the approach is less than equitable to latecomers who lose out on the resource which is enjoyed by firstcomers.

Assignment methods: Administrative comparative approach

121 The administrative comparative approach is often applied where the spectrum resource being assigned will allow only a small number of users and/or the users are commercial operators directly competing in the same service. This approach has been used widely within Europe and Canada, and the US.

122 This approach uses a process of selection assessed on merit to distinguish between rival candidates. It involves the use of invitation to tender procedures where potential operators, who may be required to meet some threshold criteria to take part in the tender, are invited to provide technical and business plans for evaluation. The NRA then evaluates these applications, often on the basis of objective (although not always public) selection criteria which may include the soundness of financial backing, technical approach, marketing approach and an assessment of the overall quality of the proposed service.

123 The approach is sometimes applied unevenly with a 'first tier' of privileged incumbent operators who may be awarded a similar licence without having to take part in the invitation to tender. This was the case in both Denmark and Germany where the incumbent mobile service operator was directly awarded a GSM licence but applicants for a second GSM licence were required to take part in a tender process.

124 Licences awarded through this process are generally for a given period (10 to 25 years), for a specified use, and are subject to annual fees. They also contain a standard clause which allows the NRA to withdraw the frequencies eg to meet international obligations. Recent licences awarded for PCN in the UK have also contained a 'side letter' which is not strictly part of the licence but which is treated as such, which sets out the technical conditions which are to be met by the licensee in order to justify the award of further frequencies for expansion.

125 Fees charged for licences awarded using this method are, in general, of a higher order than those charged for licences awarded using the first come, first served approach. They do not necessarily relate to what the value for these frequencies might be on the open market. In

France, however, consideration is being given to the possibility of setting certain fees at an estimated market value (with the aim of building a sinking fund for funding user migration), although it is not clear what method would be suitable for estimating such a market value.

126 Many spectrum administrations are currently limited, under the terms of their current legislation, to charging users licence fees which cover their costs of managing the spectrum and accordingly do not charge 'market values'. This is discussed later in this chapter when economic approaches are examined in more detail.

Assignment methods: Lottery method

127 Currently in the US no fees are charged for spectrum use, although a charge is made for processing applications. The lottery method, which has been used mainly in the US, was introduced there as an alternative to the full-scale public comparative hearings which were previously used for competitive award of frequencies. Comparative hearings, where each of the applicants is able to present its case in public, proved cumbersome and expensive and lotteries were introduced in the hope of providing a streamlined, equitable means for frequency award in cases where a limited amount of spectrum was available for a given competitive service.

128 Lotteries have attracted a large number of speculators, since any licence won by lottery has been accompanied by the effective power of resale through reselling of the operating company, which would include the operator franchise. Such licences have been awarded for a specified use. In the case of the regional cellular licences awarded in the US between 1984 and 1989, two licences were available in each area. One licence was open only to the local telephone company with the second licence being open, by lottery, to anyone who applied.

129 This approach led to a great deal of speculation, multiple licence applications, and in many cases to an immediate private auction of the awarded licence. Further thoughts are being given to modifications of the lottery process to discourage speculation, possibly through the imposition of high application fees and rigorous entrance requirements.

130 The US experience of lotteries suggests that, despite the initial apparent equitability of the lottery process, the subsequent private auction ensures that the users who are willing to pay the highest price will obtain the frequencies irrespective of the lottery process.

131 The FCC is now actively considering the use of auction methods, which may be applied experimentally this year to the award of PCS frequencies.

Assignment methods: Auction methods

132 Auction methods are the lynchpin of market-based spectrum management approaches. The key features of a market-based policy are:

- an initial auction of available frequencies to the highest bidder; and
- freedom to re-sell frequency use rights with a minimum of restrictions on the use to which they are put.

133 The goal of this approach, where it has so far been implemented, is the creation of a secondary market where users can re-sell their frequency use rights. It should be noted that both Australia and New Zealand, who are pioneering this approach, are progressing on the basis of gradual conversion of limited spectrum bands to the market based system.

134 However, some European NRAs have expressed an interest in a 'half-way house'

approach, where frequencies may be auctioned to the highest bidder, but with limited freedom to re-sell or change the usage. The aim of this approach includes increasing the revenue which can be obtained by the NRA, with the intention of using this revenue to provide improved spectrum management and/or to give flexibility in approaches to funding re-farming of frequencies and band clearance.

135 Where the goal of the auction process is the creation of a secondary market in frequency use rights, there are a number of options which allow greater or lesser freedom to the user, according to the degree of control which the NRA may wish or require to retain. These will range between:

- auction of frequencies, for a given time period, on a non-transferable basis and for a specified use (the 'half-way house' approach);
- auction of frequencies, for a given time period, on a transferable basis (ie the creation of broad property rights). These property rights may include the right to sub-divide and sell on portions of the assigned frequencies and the right of change of use (within the constraints of the requirement to avoid harmful interference).

136 Any secondary market created through the radical application of this approach would involve the effective transfer of many national spectrum management activities from the NRA to the marketplace. However, there are several major areas of concern which would need to be addressed in the context of such an approach.

137 The area of interference is one which is of particular importance in the context of wide freedom for change of usage, since this may raise problems of recourse for users who experience harmful interference from neighbouring users. Work has been going on in New Zealand on the specification of effective 'boundary rights' for users, through the definition of interference limits. In their work in this area they have had to overcome a number of difficulties associated with setting interference limits which protect neighbouring users without causing significant loss of amenity to the transmitting party.

138 Since frequencies which are suitable for mobile use are a scarce resource, unless safeguards were in place, it would be possible for a dominant operator to, for example, stockpile frequencies in order to create an effective monopoly situation. While it would be possible to apply general competition law (whether market or business law) to such cases, it might become necessary to incorporate specific safeguards to avoid such bottlenecks, such as requiring that spectrum should not be taken out of use for longer than specified periods.

5.2 Background to market price mechanism

139 The technical and physical constraints of radio propagation; treaty obligations; requirements to avoid harmful interference between users and across national borders; the range of social, scientific, safety and security applications as well as commercial exploitation of radio links; the preponderance of large, usually government related, system operators; all these factors have contributed to the adoption of 'centrally administered' regimes which, to date, have been deemed the most effective means for planning and enabling spectrum usage in European countries.

140 In general terms, a distinction can be drawn between methods of frequency assignment based on administrative rules (eg first come first served and administrative comparative methods), and those based on free market forces in which frequencies are assigned in accordance with the price mechanism (auction methods). It is evident that administrative rules have a role to play in promoting the coordination of frequency management policies across the Member States, and thereby of achieving certain technical and political objectives. However,

this does not mean that free market forces should be regarded as irrelevant.

141 Under a system based on the price mechanism, frequencies will tend to be allocated to those uses on which consumers place the highest value; it can be argued that in economic terms, such a system will promote allocative efficiency. By the same token, an administered system may reduce economic efficiency, and prevent end-users from obtaining the services they want. The size of the efficiency loss will depend on the extent to which frequencies are in short supply. The costs involved are those associated with depriving other services of access to frequencies, even though they are more highly valued by consumers ie they are *opportunity costs*. If there is little pressure on frequency availability, these costs are likely to be low. If the pressure is high, however, a system of assignment which took no account of ability- and willingness-to-pay could lead to significant losses in efficiency.

142 It is sometimes argued that the auctioning of frequencies will simply be reflected in higher prices to end-users, for the services provided over them. Since the operator bears the direct cost of the obligation to pay a high licence fee, the service will not be made available to all those users who require it. This argument is on the basis that the operator will need to constrain expenditure and maximise revenue, which will result in a subscriber base of high volume users capable of bearing high call charges. This subscriber base will be less than the total potential market.

143 There is, however, a counter-argument which asserts that the prices charged for particular services will reflect the competitive conditions in the markets concerned. If a supplier, for example, of cellular services had the market power to increase its profits by raising prices, it would do so even if it were not required to pay for the frequencies it was using. If the Government then auctioned the frequencies concerned, and the supplier won the auction, the effect would be to transfer the excess profits (or economic rent) previously earned by the supplier to the Government. The effect on the price level would be minimal. On the other hand, if the market concerned was fully competitive, the supplier would not be earning excess profits and could not afford to bid a significant amount for the right to continue using the frequencies. Its bid would be much lower but, once again, it can be argued that the effect on prices would be insignificant.

144 In many parts of the EC, the pressures on frequency availability have grown substantially in recent years, and will continue to do so in the future. This growth trend is partly a reflection of technological progress and general economic development. It is also associated with the trend towards market liberalisation, which the EC has itself been active in promoting. In this situation, there may be an increasing risk that a reliance on an administrative system of frequency assignment could lead to a misallocation of resources and constrain the future development of the sector.

145 It is likely that a range of administrative rules alongside any spectrum market would be necessary - to sustain established usage rights and non-commercial applications; to ensure recompense for existing users relocating from newly designated frequency bands; to prevent bottleneck holdings of frequencies, without recourse to broad competition law; and to constrain changes of use and technology in order to protect others from harmful interference.

146 However, in the context of a market-based policy, it would be important that restrictions were kept to a minimum; and that within those constraints, frequencies were, where possible, assigned on the basis of the price mechanism. Frequency transferability or resale would be essential if such a market-based assignment system is to respond efficiently to changing market conditions.

5.3 Current approaches to spectrum management

Making spectrum available: identifying spectrum

147 Historically, it has been common practice for NRAs to give large user-managed block allocations to major users such as telecommunications operators and government organisations. Defence users have also traditionally controlled a large amount of national spectrum. In addition, within a national administration, responsibility for management of different uses of the spectrum, such as for broadcasting, may be delegated to different bodies.

148 In these circumstances, the NRA may not itself have the unified knowledge of the occupancy and usage of spectrum which is needed in order to plan for effective spectrum use. Accordingly, the utility of detailed spectrum reviews is becoming more evident. However, funding of these reviews may be a major issue for some member states, particularly where there is no formal structure for recovering the costs of spectrum management or no authorisation for expending these sums. Several member states currently treat revenue from spectrum fees as general governmental revenue. In addition, nearly all member states exempt certain user types, usually government or public services, from payment of fees.

149 The creation of a body of information on spectrum occupancy and usage would offer wider benefits for potential users, manufacturers and other interested parties, if this information was made openly available. Due to the constraints of commercial (and military) confidentiality and to data protection provisions, any such information base would need to be provided at a relatively anonymous, aggregated level. Nevertheless, such publicly available information would be of great value to manufacturers in the initial stages of planning new radio systems by allowing them to pinpoint available spectrum and to make judgments based on the occupancy and usage of adjacent frequencies. The value of this information would be greatly increased for manufacturers according to the number of member states for which it was available.

Proposed position

Member states should be encouraged to publish national allocation tables and to make non-sensitive summaries of frequency assignments available for consultation by potential users, manufacturers and other interested parties.

Making spectrum available: release/sharing of military frequencies

150 Negotiations for the release or sharing of military frequencies is becoming of greater relevance in the search for more usable spectrum. There is a need to negotiate both at a national level and at a European level to ensure a satisfactory outcome. Currently around 33% of spectrum in the range 30-960 MHz in Europe is used for governmental (including Defence) uses. ARFA, which coordinates military spectrum planning for those nations within NATO, is currently reviewing the NATO Joint Frequency Agreement which sets out the conditions under which civil administrations agree to support military frequency requirements.

151 It is expected that the 1-3 GHz band, where a large portion of the band is currently shared between civil and military users, will be the focus for the majority of revisions in military allocations. However, the Chairman of ARFA recently stated that the total quantity of spectrum required by the military will not fall, but that it will be used less frequently. On this basis spectrum would only be released on a pre-emptible basis, to be taken back by the military when needed.

152 At a national level, individual NRAs have also been negotiating with the military for release of frequencies for civil use. These are often released on a geographic sharing, pre-

emptible basis. In some cases, as in Spain, such agreement required funding for changing the frequency tuning of existing military equipment.

Making spectrum available: re-farming of frequencies

153 In several cases, as a result of historical evolution, NRAs are faced with the problem of bands in which assignments can no longer be made on an efficient basis. The major constraint on any re-planning of the band is existing user investment in equipment. The approach generally taken by NRAs is to plan migration on a long-term basis (for example 7 years) to enable users to plan for change.

154 This problem of funding user migration on re-farming of frequencies is part of the wider debate on funding of band clearance to allow more effective usage of spectrum. Related issues include funding the expenses of re-tuning/replacement of equipment and the additional costs incurred by existing users of migration further up the spectrum. Since NRAs are, in the main, legally limited to recovering the costs of administering frequency licensing, there is no provision for funding the migration of existing users.

155 One approach to this problem, adopted in France as part of an overall strategy for re-farming a band which contained an inefficient mixture of PMR relays and public network fixed links, has been to set a condition for incoming operators to fund the migration expenses of existing users. This solution is, however, dependent upon a reasonable agreement between the parties as to the true expense to the user of migration. It is also dependent upon the incoming operator being able to afford the expense of funding migration.

156 A further funding approach which has been discussed but which has not yet been adopted by any member state is the creation, through 'market value' frequency licence fees, of a sinking fund which would be used to fund user migration.

Proposed position

Member states should follow active programmes to increase availability of frequencies in established bands for civilian mobile communications. These programmes may include national reviews of spectrum occupancy and usage, flexible sharing with military users and the development of strategies for replanning of frequency bands.

Encouraging effective use: administrative approaches (cost-covering and price-oriented)

157 Currently, except for recent market-oriented innovations in Australia and New Zealand, the most common economic approach to spectrum pricing taken by NRAs worldwide is on an administrative cost-covering basis. Historically, member states have tended to consider spectrum as a national resource which is managed with little reference to commercial pricing aspects, often on the basis that the radio spectrum belongs to the public domain in the same way as sovereign territory.

158 Licence fees, where charged, are on an annual basis and represent an annual rent for use of frequencies. In some cases one-off charges are also made on award of a licence and associated frequencies. In several countries the true administrative cost of spectrum management is not reflected accurately in the licence fees charged. Fees may, for historical reasons, be set at nominal rates on the basis of 'general taxpayer pays' rather than 'user pays'. In the absence of detailed information about the true cost of regulating the spectrum, there may be difficulties in apportioning costs. Additionally, most member states also grant a variety of exemptions, usually to the military, broadcasters and government users.

159 As noted earlier in this chapter, in a number of member states fees collected from spectrum users are paid directly into the Treasury, where they become part of the government's income. However, in Denmark, Portugal, Germany and the UK these fees are used directly to cover the administrative costs of managing the spectrum, and to fund research and development into spectrum planning. Accordingly, the majority of member states, either explicitly under the terms of their current legislation or effectively through historical precedent, are restricted to charging users licence fees which cover, at most, their costs for regulating use of the spectrum.

160 This cost-covering approach to funding national spectrum management, especially where combined with a nominal fee structure, major user exemptions and spectrum revenue being paid directly into the national Treasury, can lead to difficulties for NRAs in funding programmes such as national spectrum reviews and in raising funds to cover the costs of existing user migration. As noted earlier in this chapter, detailed spectrum reviews are a vital first step to identifying areas of spectrum which have the potential to be reclaimed and re-allocated for a different service use. Similarly, NRAs wishing to take an active approach to band clearance and re-farming of frequencies are increasingly facing the problems of funding such programmes, particularly in the context of a cost-covering administrative approach.

161 As noted above, several member states have begun to develop some practical solutions to some of these problems, within the constraints of the administrative cost-covering approach, which take account of operator willingness to pay. This approach, which could be termed a 'price-oriented administrative approach' has two main features:

- funding of migration of displaced users by the incoming operator;
- the introduction of a degree of differential and/or scarcity pricing (within the bounds of administrative pricing of a 'basket' of channels) in order to reflect to some degree the value of spectrum to users for given ranges or geographic areas.

162 Agreement by the incoming operator to pay the migration costs of sitting tenants has occurred recently both in France (PAMR licensees) and the UK (PCN licensees). It is also currently a feature of FCC plans for PCS spectrum (in the 2GHz range) that incoming operators agree to fund the migration costs of sitting tenant fixed link users. Such agreement can have the additional advantage that the current users may be able to stay in situ in some cases, until operator expansion occurs. However, it is not clear what role could legitimately be taken by the NRA in ensuring that both operator and user reach agreement about compensation, in case of disagreement.

163 Several NRAs, including Germany and the UK, have begun to apply aspects of differential and/or scarcity pricing in setting recent licence fees for competitive operators. These fees may be applied both at the initial grant of a licence and subsequently on release of expansion frequencies to operators. However, NRAs using this approach have limited scope for imposing fees which can be said to truly reflect the market value of the resource, since they are working within the limitations of an overall cost-covering approach. It is difficult, therefore, to argue that the fees charged in any way reflect the true market value of the resource and, therefore, that they provide sufficient incentive for users, for example, to migrate towards higher frequencies and release lower frequencies for radio-essential applications.

Encouraging effective use: market-based pricing

164 Increasing commercial exploitation of radio spectrum, growth of demand for mobile communications and the entry of commercial operators have led to continuing debate on both the economic value of the spectrum and the utility of market pricing as a means for encouraging more effective spectrum usage. It is argued by proponents of this approach that the charging of economic rents would allow NRAs to obtain increased revenues which could be used to provide improved spectrum management. At the same time it would discourage non-(radio)

essential applications by highlighting the opportunity cost of the resource, stimulate users to use more technically efficient systems and technical approaches in order to get the best performance from their frequencies and, through differential pricing of spectrum, encourage user migration to higher (and currently less congested) frequencies.

165 The issue of market-based pricing is coupled with a further area of debate, on the degree to which market mechanisms may be used to in setting an open market price for frequencies as outlined in 5.2. This involves the establishment of a private spectrum market for the trading of licences and, in some scenarios, the creation of "management rights" which allow holders to issue usage licences to third parties for part or all of the "managed" frequencies. In the most extreme scenario, such licences will directly authorise access to the spectrum and will not be restricted to particular uses or particular equipment, although licensees are subject to statutory obligations and minimum standards designed to avoid radio interference. An essential feature of this approach is the initial auctioning of frequencies, as described in section 5.1, accompanied by the freedom to re-sell frequencies with a minimum of restrictions on the use to which they are put.

166 This approach is in marked contrast to the more universal practice of issuing spectrum licences which specify both the service use and equipment parameters which apply to individual licensees on a non-transferable basis.

167 In 1989 New Zealand and, most recently Australia (in July 1993) have adopted elements of this market-based approach, including a commitment to the creation of management rights. While many NRAs are following developments in Australia and New Zealand with interest, it is generally acknowledged that these countries have greater freedom to introduce these practices, due to their geographic isolation and lack of commitments to bordering country frequency coordination. It is therefore unlikely that the issuing of such "derestricted usage" licences would be seen as a practical approach within Europe.

168 In the US, the auctioning of radio spectrum licences is apparently becoming increasingly favoured by the FCC. It is planned, initially, to carry out an auction of not more than 30MHz in the PCS band during 1993. Congress will then consider the competitive effects and, if it is considered to have been successful, the FCC would gain authority to continue with this approach. However, it is not yet clear to whether the FCC intend this to be a first step towards a radical market-based system or a half-way house approach, giving minimal long-term tradeability rights.

169 There is no strong indication of intention to adopt these more radical open market approaches in Europe, although several member states are considering adopting some elements of the market-based approach, on a half-way house basis.

Technical approaches: effective exploitation conditions

170 Whilst pricing mechanisms are intended to contribute indirectly to effective spectrum usage by reflecting the scarcity and differential values of frequencies, a more direct approach which is increasingly being used by NRAs to ensure effective spectrum usage is the imposition of technical conditions upon operators, usually through terms and conditions of licensing, to ensure effective exploitation.

171 Technical targets may be reflected in frequency allocation and assignment policies which favour those systems and practices which offer improved spectrum exploitation. This occurs when NRAs designate available spectrum for use in more efficient trunked PAMR systems and services, rather than for dedicated PMR networks - as for example in cases in France, Germany, and the UK. Technical targets may also be incorporated through requirements to use assigned frequencies with approved systems specifying, for example, use of digital transmission and TDM multiplex techniques - or more progressively by requirements

to have introduced narrower channelisation or lower-rate coding and compression schemes by a nominated stage.

172 A licensing approach may be used to regulate operator access to frequencies by requiring that conditions based on defined measures of effective spectrum exploitation are met in order that an expansion of assignment can be considered (or indeed to avoid a reduction of assigned frequencies). Such an efficiency measure might reflect channels / MHz / square km achieved for some part of the operator's network. Some member states are already applying such technical requirements to certain operators, for example in Germany and the UK for cellular operators, and in the US for Shared Mobile Radio (SMR) operators. In the case of SMR operators, channel loading is reviewed five years after licensing. Further expansion channels are assigned if the specified threshold loading has been achieved, otherwise existing channels are withdrawn and the operator licence is cancelled.

173 NRAs also have the option to directly monitor usage by operators. This monitoring on a sampling basis can give a reasonable, but not comprehensive, indication of the usage of the spectrum. Monitoring is usually carried out by land-based monitoring stations and also through mobile units which can act as roving monitors for targeted geographic areas. However, such monitoring by the NRA is an intensive activity and would be unsuitable for use as a mass means for monitoring usage.

174 The imposition of technical conditions by the NRA, where the operator has to demonstrate that currently assigned frequencies are effectively used before new frequencies can be released, allows the regulator to retain the option to claw back frequencies where these cannot be shown to be effectively utilised. In addition this approach, to a large extent, transfers the burden of demonstration to the operator.

Effective exploitation

175 Both technically based usage conditions and economical (or pricing) approaches can be effective in exerting direct or indirect pressures on radio system operators to use less congested parts of the spectrum and to employ technology or network configurations which achieve increased service capabilities from assigned frequencies.

Proposed position

Member states should be encouraged to adopt frequency allocation and assignment policies which impose upon mobile network operators conditions (based on technical and/or economic factors) promoting the increasingly effective exploitation of assigned frequencies. This might include the use of market pricing for frequency usage rights.

Technical approaches: resolution of harmful interference

176 Because of the number of land borders in Europe (for example Germany has to consider 9 neighbouring countries), member states generally need to liaise closely with neighbouring countries, in order to avoid harmful interference and to ensure effective usage of spectrum close to borders. Traditionally, neighbouring countries have cooperated closely on a bilateral and multilateral basis to sort out common problems and produce coordinated frequency assignment plans. From this cooperation, several member states (Belgium, France, Germany, Italy, Luxembourg and the Netherlands) have become signatories to the Vienna Agreement, set up for frequency coordination in border areas. The Agreement is currently under review, for inclusion of more sophisticated measures. Other member states who are not signatories, such as Portugal and Spain, Ireland and the UK, cooperate with neighbouring countries on a

bilateral basis.

177 The ERO, which is currently developing a European terrain database which takes account of border areas is also considering European frequency coordination issues. In Phase 2 of the Detailed Spectrum Investigation, just being launched, the ERO will invite public comment on whether a frequency coordination agreement should be established in border areas for all CEPT countries. It is suggested that it may be possible to accomplish this through an extension of the existing Vienna Agreement.

Proposed position

The EC should encourage and support the extension of current multi-lateral cooperation on frequency coordination towards a general agreement for frequency coordination in border areas for CEPT member countries (and particularly throughout the EC).

Proposed actions for the CEC

- **The CEC should place work requests on ERO/ETO as appropriate to develop common guidelines for good practice in spectrum management in member states, to cover areas including:**
 - **publication of information on allocations and assignment summaries;**
 - **active programmes for spectrum release;**
 - **effective spectrum exploitation criteria in assignment procedures.**

- **The CEC should initiate a programme of studies (through ERO/ETO or otherwise) to develop technical and economic information on characteristics of a range of alternative management methods which could promote increasingly effective use of frequencies, particularly in the field of mobile telecommunications. Technically oriented methods to be addressed could include: preference for particular technology features (eg trunked operation, code division multiplexing or low-rate digital coding) or the setting of network operational targets (eg channels/MHz/square km) for retention or expansion of assignments. Economically oriented methods to be addressed could include price-based markets for frequencies (including auctions and secondary markets), administrative pricing (eg through premium fee structures) and the funding of band clearance and migration (through the proceeds of fees, through obligations on incoming users, through market mechanisms).**

- **The CEC should consider placing a work request on ERO to develop the structure and terms for a general agreement on frequency coordination in border areas of the EC.**

6 Spectrum issues for emerging services for personal communications

178 The area of personal communications mobility is expected to be the focus of major development and implementation over the next two decades. In this section possible EC level action in the near term is considered which may be needed to ensure a sound foundation in spectrum planning in the region to foster these developments. This summary draws on material from Appendix 1, section 2.5 which presents further information on this topic.

Background to personal communications

179 Personal communications services (PCS) aim to meet the needs of mass market users for voice communications with hand-held, relatively low-power terminals, supporting dense user populations (although with comparatively modest traffic per user) as well as serving the more traditional mobile telephony market (including vehicle-based use and data applications).

180 Second generation cellular mobile services (for example based on GSM technology and particularly on DCS1800 systems) will start the provision of PCS over the next few years in some European countries (including Germany and the UK). GSM networks, at least, are expected to be interconnected to support Europe-wide roaming of terminal users.

181 In the second half of this decade mobile satellite services are likely to be launched to provide PCS service on a world-wide basis - with particular ability to serve remote or rural areas which are not well-served by terrestrial network facilities. A number of such satellite systems are currently proposed, all by US based consortia, to employ multiple satellites in low earth orbit (LEO) configurations. These service proposals include options for multi-mode user terminals which would be capable of accessing both terrestrial networks (such as GSM in Europe) and the satellite service (when out of terrestrial coverage). A further proposal, by INMARSAT, has yet to define its satellite system configuration.

182 At present there appear to be no initiatives by European industry for a European based LEO system for personal mobile communications.

183 Third generation mobile systems for possible introduction from around the year 2000 onwards are being studied by the CCIR - under the title Future Public Land Mobile Telecommunication systems (FPLMTS) - and in Europe under the RACE programme and within ETSI, with the title Universal Mobile Telecommunications System (UMTS). These concepts are currently at the research stage, but standardisation work in ETSI will be coordinated with that of CCIR so that UMTS is intended to become FPLMTS.

184 FPLMTS is aimed at convergence of present mobility services (including cellular, domestic and business cordless telephone, paging, etc) into a unified network technology for access and support. This will be based on a standardised system providing mobile communication (including for hand-held personal terminals) in any location - office, street, vehicle or home; indoors or outdoors, in urban or rural areas. A wide range of services are envisaged, including ISDN capabilities and B-ISDN (broadband high bit-rate services). Current mobile service capabilities, such as those of GSM and DECT, would thus be subsumed in the new systems, with improved performance and quality.

185 In addition to terrestrial network service, the FPLMTS concept includes extended coverage through an integral satellite component (for remoter land regions and possibly ships and aircraft) with the goals of automatic handover between satellite and terrestrial parts and terminals with integrated satellite access. Both regional and world-wide roaming capabilities are envisaged for FPLMTS.

186 The overall timeframe envisaged for FPLMTS, indicated in a Resolution adopted at the WARC-92, is that initial implementation of the terrestrial part is expected to occur around the year 2000, with the satellite extension introduced some 10 years later.

Spectrum issues for mobile satellite provision of PCS

187 WARC-92 made several spectrum allocations for mobile and mobile satellite services. These allocations would facilitate the implementation of LEO satellites and FPLMTS, subject to a number of conditions, coordination procedures and time frames for introduction into service. The Mobile Satellite Service (MSS) allocations do not specify whether certain bands are to be used for geostationary orbit or non-geostationary orbit satellites.

188 The implementation of new systems have to contend with several problems. The allocated bands are in most countries among several co-primary services, which may be incompatible. The possibility of sharing and the possible adverse effects on other services still need to be investigated.

189 Different countries around the world have taken different stands on the possible dates of introduction in the case of bands identified for FPLMTS, thus raising fears of future incompatibilities of use. There is also the likelihood, particularly in the case of LEOs, for which an extremely limited spectrum is allocated, that not more than a few systems can be sustained. This might result in later (ie non-US based) entrants not gaining access to the frequency bands.

190 WARC-92 made available a number of new (and generally small) allocations for the mobile satellite service in the bands around 140 MHz, 400 MHz, 1.5/1.6 GHz, 2.5GHz. The MSS systems proposed to operate below 1 GHz are the so called little 'LEOs' providing non-voice services. The allocation of 1610-1626.5 MHz to the Mobile Satellite Service (Earth to Space) is the prime candidate for the operation of already proposed LEOs for PCS. This band is likely to be paired with 2483.5-2500 MHz in the space to earth direction.

191 WARC-92 also identified further sub-bands for MSS totalling some 60MHz within the bands at 2GHz designated for eventual use by FPLMTS.

192 Because of the concerns at the WARC that the first global LEO system to be implemented by one country, organisation or company might result in *de facto* standards being imposed on the rest of the world, a further resolution was adopted. This calls for the establishment of standards for the operation of low-orbit satellite systems and in particular resolved that the ITU would carry out..." as a matter of priority, technical, regulatory and operational studies to permit the establishment of standards governing the operation of low-orbit satellite systems so as to ensure equitable and standard conditions of access for all countries and to guarantee proper world-wide protection for existing services and systems in the telecommunication network." CCIR Study Group 8 is currently in the process of developing recommendations on the coordination methods, orbital parameters of non-Geostationary satellite networks and sharing criteria. The same Study Group is also responsible for developing recommendations on the establishment of standards for the operation of LEO systems.

193 The WARC-92 allocation of spectrum for MSS at 2GHz within the broader bands designated for FPLMTS currently gives rise to a number of concerns. On a general world-wide basis the allocation becomes effective from the year 2005, frequencies should be made available for FPLMTS within the overall context and timeframe of an integral satellite service component, and are subject to certain coordination and notification procedures for non-geostationary satellite networks. However, a footnote provision for the USA introduced the possibility for use of these bands to commence from 1996, with some uncertainty as to the

applicability of the additional conditions. More generally, the allocations for FPLMTS are not exclusive and issues relating to the feasibility of sharing these bands with non-FPLMTS services (mobile or fixed) have yet to be resolved.

194 The possibility of earlier introduction of MSS at these frequencies in the USA has given rise to concern as to the availability and compatible use of these bands for the FPLMTS as well as for other mobile satellite systems (for example in new services from INMARSAT). Prospective coordinated introduction of a global FPLMTS service must remain doubtful while significant differences remain in dates currently agreed for the introduction of satellite systems in these bands in the USA and elsewhere, and in relation to the overall timeframe anticipated by CCIR Resolutions - for a terrestrial part around 2000, with satellite extension around 2010.

195 The FPLMTS satellite band allocations are likely to be reconsidered at future Radiocommunications Conferences. The possibility could be considered of seeking a revised timing for availability - to come into effect earlier and closer to the planned introduction of terrestrial elements of FPLMTS (eg around 2000, providing the transitional relocation of existing fixed service systems can be adequately accommodated). It might also be valuable to have identified some core spectrum on a worldwide basis for the satellite element of FPLMTS in order to support some development and implementation of the satellite component in tandem with overall introduction of FPLMTS.

196 In early 1993 ETSI established a project to consider problems raised by the introduction of LEO satellites and mobile communications systems which use LEOs - including their role in future systems such as personal communications networks, compatibility with current systems such as GSM, the protection of other radio systems, and potential need for European Standards. By early July 1993, the first stage results were completed and due to be published subsequently in the form of a European Technical Report (ETR).

197 Development of personal communications, and especially mobile satellite elements (including LEO systems) is being conceived on a global basis. However, many uncertainties concerning market evolution, approaches for integration of satellite and terrestrial elements, and the timeframe for key stages can be seen to exist at present. Potential differences are already apparent between industry views in the USA and those elsewhere which may lead to early implementations and potential advantage for USA based positions.

198 It could be difficult to counter these developments, and maintain a full range of opportunities for European industry and operators, in the absence of a concerted viewpoint in Europe on the European (and world) market prospect, the implementation and evolution options, and issues particularly with regard to the availability and use of spectrum for integrated mobile satellite elements of personal communications networks. At present, it appears that individual member state administrations have not established national policies regarding strategies for FPLMTS or satellite personal communications.

199 Coordination of views between Europe and the US on aspects of the developing mobile satellite service area and LEO systems is a potential activity for a Cooperation Group recently set up between CEPT/ERC and the US regulatory bodies (FCC and NTIA), for regular discussions on matters of general mutual interest.

200 The CEC is already in the process of initiating a study on satellite personal communications networks (including LEOs) and their consequences on European trade and industry. This study is expected to commence in the second half of 1993 and is aimed at the identification of policy issues and directions in the fields of market regulation and support for industry over a broad sector of emerging terrestrial and satellite based mobile communications.

Proposed position

To support development of personal communications services in the EC and to enable a cohesive European position to be promoted in world fora for spectrum planning, a common EC position should be developed and agreed on the role of satellite systems in providing personal communications and the associated requirements for frequencies for the mobile satellite service and their planned availability in the European region and elsewhere.

Broad strategy for the developing personal communications market

201 A considerable period of research and development is anticipated for the FPLMTS concepts, before the realistic planning of new service introduction by operators. ETSI and the CCIR have standardisation activities planned for the next 5-6 years. However, the PCS market will initially evolve through second generation mobile systems over the same timeframe and the European equipment industry and service operators are both likely to seek an extended period of exploitation for GSM and other systems into which considerable development efforts and investment costs are still being sunk.

202 A common EC strategy view on market prospects and requirements, developed in line with the proposals made in Chapter 4 for support to frequency harmonisation activities, would be appropriate for the PCS area.

203 Initial designation of common frequency bands has already identified significant prospective spectrum provision for the evolving PCS application. Through CEPT Recommendations, a total of more than 80 MHz at around 900 MHz has been designated for use by GSM systems (including extension bands identified for use on a national basis) and a further 165 MHz at around 1800MHz designated for use on a national basis for DCS1800 systems. Additionally WARC-92 identified further spectrum totalling 230MHz at 2GHz for implementation of FPLMTS (including sub-bands for mobile satellite service), though this has not yet been confirmed through European harmonisation procedures.

204 However, in all European countries most of this spectrum is currently used either for military applications or for fixed-link telecommunications, and significant clearance and relocation programmes would need to be planned to make frequencies available for PCS over the next 10 -20 years. In preliminary studies for Detailed Spectrum Investigations (1 - 3GHz), ERO has estimated the number of existing fixed radio-relay systems operated in CEPT countries in the bands 1900 - 2300MHz - much of which would have to be relocated to clear frequencies for implementation of FPLMTS - at around 8000 links. Early replacement of significant proportions of this equipment (even at year 2000) would represent a significant cost to operators, or for some compensation mechanism.

205 The ERO work also identified alternative options for such a clearance and transition process for the spectrum around 2GHz for possible evolution scenarios from cellular services of this decade to the situation post-2000 with the introduction of FPLMTS. Some equipment suppliers have suggested however that full economic exploitation of GSM based systems (including the related DCS1800) might argue for deferring deployment of new FPLMTS technology until well past 2010; with suitable early planning, this could permit any existing use of frequencies at 2GHz to be phased out after its useful economic life, with no imposed costs on the operators.

206 Frequency provisions for PCS, including for FPLMTS, thus need to be set in a thoroughly considered market context. This needs to examine the likely attractiveness and success of FPLMTS in Europe and elsewhere (including the prospect for a terrestrial only FPLMTS in some territories, where very extensive coverage can be offered), whether FPLMTS would provide sufficient user benefits to warrant migration from established second

generation cellular systems for PCS - and over what timescale. Additionally, the prospects should be assessed for FPLMTS in gaining market from possible hybrid PCS services, which might for example have combined terrestrial GSM with LEO satellite service.

207 Such a market appraisal would inform consideration of the likely degree of cohesion in Europe over introduction and deployment of PCS in general and FPLMTS as part of a world-wide service. It would also permit a re-evaluation of the bandwidth needs for PCS or FPLMTS in the region; of the opportunities there might be to consider further services for use of the identified bands (perhaps favouring innovative technology solutions promising new levels of effective spectrum exploitation); or of additional options in managing the transitional relocation of existing fixed link users to other bands.

208 An opportunity should also be provided to consider competition and related regulatory issues for the overall personal communications market. An initial factor would be to ensure that possible modes for competitive provision within the PCS supply market were examined together with their implications for efficiency in spectrum use and any resulting adjustments to bandwidth requirements. Market supply structures might include multiple operators with terrestrial infrastructure and multiple operators of mobile satellite components, plus a variety of service provider structures to supply terminals and communication service to end-subscribers. The original CCIR bandwidth estimates for FPLMTS, on which allocations at WARC-92 were based, did not consider the situation of multiple operators serving a given territory.

209 An important regulatory consideration for FPLMTS will be whether it is considered to be a distinct market (possibly containing competitive suppliers) or whether the overall PCS market is considered to be much wider and to contain other operators (and end-service providers) based on GSM systems, DCS1800, LEO or other mobile satellite systems as well as FPLMTS. Issues will then arise concerning whether operators with spectrum in one part of the market may additionally be assigned new spectrum for FPLMTS (in the UK and Germany, for example, existing operators with GSM frequencies were excluded from participation in the DCS1800 band). There may also be considerations of the comparability intended between terms (including economic factors) for use of new spectrum and those already applying for established bands in which some of the overall market competitors will be operating.

210 A market oriented view of this type could also influence positions on the options available and anticipated outcomes in retiring previous generations of mobile service in conjunction with the planned introduction of FPLMTS - and the possibility of releasing spectrum which they were occupying.

211 The CEC could play a constructive role in encouraging coordination and consolidation of the various groups presently examining aspects of PCS and FPLMTS (including in CEPT, ETSI, RACE) with its own investigations, and emphasising the examination of market prospects as well as more technically oriented research and development issues. A more concerted view at the European level would provide an important framework and guidance for preparatory activities such as planning for spectrum use.

Proposed position

To provide a strategic framework for long-term frequency management and planning for personal communications services in Europe, a common EC position should be developed and agreed on the broad prospects for the evolving service market (including opportunities for competition and for innovations in technology) and associated options for meeting spectrum requirements for personal communications systems.

Proposed actions for the CEC

- **The CEC should commission a wide ranging study of the role of satellites in delivering PCS in Europe and associated frequency requirements. Subsequently the CEC, through ERO, should seek agreement within CEPT on appropriate European Common Proposals incorporating such MSS frequency requirements to guide member state participation in future Regional and World Administrative Radio Conferences.**
- **The CEC should commission a market oriented study of the potential evolution of PCS and FPLMTS services in the EC, including spectrum implications. The CEC should ensure that relevant results are contributed to the CEPT Detailed Spectrum Investigation process, and should consider preparation of a Council Resolution to endorse a common strategic direction for PCS and FPLMTS in the EC.**

7 Infrastructure options for competing fixed-networks

212 Where liberalised regulation permits competition for public fixed network operation, including for local service, then wireless local loops offering a rapid and cost-effective alternative to cable construction could become a particularly significant factor for potential new market entrants, including for penetration of major urban markets. In the majority of member states little consideration appears to have been given as yet to this prospect.

213 This chapter draws on more extensive background material presented in Appendix I particularly in section 2.7.

Radio in the local loop

214 In fixed-network infrastructure, the local network implements an internal link (the "local loop") to a network termination point - generally provided at a subscriber's premises. The service interface to the subscriber's terminal equipment is provided at the network termination point; the provided service is for fixed terminals - although the user may employ a terminal system which incorporates cordless access at short range on his premises.

215 Thus implementation of fixed local loops may be distinguished from provision of service direct to mobile terminal users - although the latter may enable interconnection to the fixed PSTN, possibly embody public cordless ("telepoint") access, and increasingly offer an alternative to fixed service.

216 Use of radio technology in the provision of wireless local loops can enable rapid construction of local service infrastructure and (except for very high density provision) both initial investment and subsequent maintenance costs are now expected to be below those for new cable constructions.

217 These features make the use of wireless local loops attractive for rapid upgrades to telephone service density in under-developed territories, and could also be relevant in upgrading developed networks to provide universal service in rural areas (particularly for new digital services).

218 Within current monopoly approaches for public fixed-network infrastructure, this is the role for radio systems at present acknowledged in most member states. Adapted mobile radio technology has been employed in this way for PSTN development in the new Bundeslander of Germany. Elsewhere, in the CIS and in Latin America for example, similar approaches have been adopted; multiplexed radio channel systems have also been deployed for many years for rural telephone service in parts of north America - again within a monopoly approach for local public infrastructure.

219 The UK is the prime example where competition has been permitted in local public network infrastructure. However after some 10 years of limited infrastructure competition (including opportunities for telecommunications supply by cable-TV network operators) the penetration of alternative local network service - particularly for residential and small business subscribers - has remained low. Following further relaxation of licensing, a number of potential operators are now proposing to provide PSTN service specifically based on wireless local loops; licences have been issued to initial new operators, although the new networks have not yet started service.

220 EC policy on competition in basic public telecommunications is still evolving, mainly in relation to the time schedule towards a fully liberalised environment. If the EC establishes a policy for competition at some stage in provision of all public network infrastructures, then the emergence of real competitive choice at the local service level for smaller users could be significantly encouraged and accelerated if new operators are able to deploy wireless local loops to serve subscriber premises. Conversely, if such an option were not available to fixed-

network operators then the development of competing local service networks could be restricted in practice.

Proposed position

In the event that EC policies are developed for competition in provision of public network infrastructure and telecommunications services, appropriate frequencies for wireless local loop operation should be made available in all member states, to meet the commercial needs of authorised network operators.

Technology and frequency options

221 Wireless local loops may be implemented as point-to-point fixed links, or as point-multipoint systems with permanent channels (eg via time-division multiplexing). However, for cost-effective provision of public telephony (or other narrow band services) with appropriate grade of service and with efficient use of the radio spectrum, wireless local loop implementations are likely to be based on point-multipoint radio solutions employing contention for dynamic channel selection for subscriber links. Technical requirements for this are very similar to those of systems for mobile radio-communications, and could be met through adaptations of existing or emerging technology for cellular or cordless access systems.

222 In the short term such adaptation and the use of a frequency band designated for mobile service (or close by) would be likely to represent the easiest approach to products and implementation for wireless local loops. However point-multipoint systems could also be designed for other bands (typically at higher frequencies).

223 Where there is little pressure on availability of frequency channels for the related mobile service (ie in rural areas or other territories with sparse demand for mobile communications) then the use of mobile frequencies might be acceptable. However, in urban locations diversion of frequency resource in this way could hinder the full commercial development of networks and services for mobile users, on behalf of a fixed-link application which is not fundamentally dependent on the use of radio spectrum.

Proposed position

Member states should be encouraged to provide frequencies for wireless local loop operation for fixed-network infrastructure in a way which does not significantly impede the development of services to mobile users in the EC.

224 In the UK, it appears that new operators proposing to implement wireless local loops plan to employ frequencies assigned from fixed service allocations at around 3GHz. Proposals for a common European table of frequency allocations contained in the 1993 report of the first CEPT Detailed Spectrum Investigation also identified a band in the 3GHz region for possible use of point-multipoint fixed links. ETSI has recently initiated a study of the applicability of existing standards for mobile systems (including GSM) to wireless local loop systems and of needs for longer-term standardisation.

225 It seems likely, therefore, that a considerable range of options will exist for technology and spectrum location for wireless local loop operation.

226 Fixed local loops are internal network links which do not themselves determine a subscriber interface or required terminal characteristics. Industry standardisation and European harmonisation in this area could thus contribute to a single market for network equipment (and

possibly for component technology), but are not factors for a European terminal market or for pan-European service capabilities. Nevertheless, an assessment of the range of suitable technologies for wireless local loop implementation and their associated possibilities for choice of spectrum use would provide a valuable background to spectrum planning for this application in member states.

Proposed position

Studies assessing possible technologies for wireless local loops and their associated spectrum options are needed to provide background information for spectrum planning in this area in member states.

Proposed actions for the CEC

- **If EC policies are developed for competitive fixed network infrastructure provision, the CEC should support these through proposal of a Council Recommendation calling for appropriate frequencies for wireless local loops to be made available in member states, and enabling the CEC to review its application in the light of subsequent progress in the development of competitive markets.**
- **The CEC should consider placing work requests on ERO/ETSI (or others) as appropriate to study a range of technical options for wireless loop applications, their associated spectrum requirements, and the potential for European harmonisation in this field.**

8 Frequencies for cross-border network operations

227 Availability of networks with cross-EC coverage is a cohesion target for the further development of the EC, and mobile networks with multi-national coverage (and an infrastructure which spans national borders) are a potential outcome of policies for liberalisation and operational flexibility in this sector. Such developments would introduce new requirements on the ways in which network operators are authorised to use radio frequencies in member states.

228 Such requirements are considered in this chapter, which draws on background information presented in Appendix I, particularly section 2.4.

Cross-border opportunities

229 With realisation of the common market in the EC, it is expected that cross-border commercial activity will increase and it can be anticipated that increasing numbers of businesses which previously operated on a local region basis within individual member states, will in time develop their activities to cover regional areas which span national borders. This could generate a demand for self-provided PMR networks (in particular) which can operate over matching cross-border regions to support such business activities.

230 Operators in this situation would wish to be able to indicate their need as part of a procedure in which national regulatory administrations cooperated to facilitate appropriate licensing and frequency assignments.

231 As an alternative to self-provided PMR networks for such border-spanning businesses, shared access trunked PMR services could provide similar regional radiocommunications coverage but with more effective use of the spectrum. Potential providers of such services would also need to seek authority both for operations and for frequency use on a multi-national basis.

232 Increasing market interest in cellular radio telephony and liberalisation developments in competitive supply could also lead to a demand for opportunities to establish cross-border operation of public mobile networks. This could arise in a number of ways.

233 Licensed operators of individual national mobile networks may develop particular direct interconnection arrangements with similar networks in neighbouring countries - perhaps where there are common consortium participants or in furthering other joint venture commercial liaisons. Thus an operator group may develop multi-national interests in gaining or expanding frequency assignments.

234 This multi-national operation might lead to some integration of network operations aimed at improved efficiency and service to subscribers, and thereby to adjustments to the combined network architecture and the re-grouping of cell and switch coverage particularly in border regions. As a result, the original operator group could seek additional authorities for border zone operation and for frequency use in adjacent countries. Common assignments of the same frequencies for use across the entire network are not necessary; operators already cope adequately with different channel groups for use on a geographical basis.

235 In an alternative development, demand might arise from a new operator wishing to construct a pan-European network for mobile service, competing across a number of EC countries. Such a service provider could offer Europe-wide service to subscribers without inter-system roaming. If the network infrastructure could be built without regard to national boundaries then the cost structures for cross-border traffic might be significantly different from those of discrete interconnected networks, allowing innovative end-user service tariffs.

236 However, the emergence of such a trans-European mobile network would probably require a pan-European collaboration of national regulatory authorities in a special joint decision process to seek such operator(s) and award relevant operational licences in all territories. This special process could be expected to extend to associated co-ordination of frequency assignments, at least for all border regions to be covered, within a pan-European common allocation for the service. Furthermore, some regulators remain unconvinced of the potential competitive benefits of possible trans-European network operators over the interworking of nationally based networks to achieve pan-European mobile service for subscribers. Objections raised included the potentially anti-competitive effect of a major trans-European operator; for services which are practically limited to a small number of competing operators, a common operator presence could reduce the freedom of member states to select other service alternatives as a national use of the relevant frequencies.

Multi-national operations

237 At present, for public services, cross-border service availability is achieved through interconnection and interoperation of nationally operated networks, which are engineered to provide radio coverage within national boundaries (and subject to coordination procedures to prevent harmful cross-border interference).

238 Multi-national service coverage for users can thus be provided through inter-system roaming, without the requirement for any individual operator to construct cross-border or multinational radio-based infrastructures. Harmonised specifications for digital systems such as GSM and TETRA extend this ability and allow interconnect/roaming solutions not only for cellular telephony but also in trunked PMR services for professional user groups.

239 It seems likely that for both mobile telephony and PMR (through trunked public access services), user roaming between interconnected (but nationally structured) service networks can meet the majority of requirements for cross-border communications coverage. Furthermore, for networks of a significant scale, the impacts of structuring individual network coverage to recognise national boundaries rather than employing more optimal architectures for border zone transmission coverage seem unlikely to be fundamental.

240 Interconnected operation of distinct nationally based networks therefore could continue as the principal approach to providing cross-border mobile service. However, it is increasingly likely that particular operator groups will plan service operations in multiple countries and will thus need to achieve authorisations from a number of national administrations.

241 Frequency assignment and the licensing of frequency usage is currently entirely a matter for national administrations. All EC member states require in some manner that a network infrastructure operator who is to be licensed to use frequencies in the operation of radio-communications equipment is already authorised in that country to provide the infrastructure-based service for which the radio system is required. A variety of approaches is adopted in establishing these two elements of authorisation for radio-based networks - some member states licence service operation in combination with the assignment of frequencies, others separate the frequency usage licensing (and may have a variety of procedures under which the service operation is authorised, or exempt, for example depending on whether or not the prospective operator fulfils some role in public service or utility provision).

242 During 1992 a review of frequency licensing procedures across Europe was commenced by the Radio Regulations working group of CEPT/ERC in preparation for proposals for more common approaches. However it was concluded the diversity of procedures in use was so wide that there was no realistic prospect for a common approach, and the investigation was not continued. It seems likely that much of the diversity arises through service authorisation aspects rather than the technical assignment of operating frequencies.

243 Establishment of harmonised procedures for licensing infrastructure network operations for service provision in member states would be desirable to facilitate authorisations for those network providers whose operations do have a multi-national dimension; however, considerable hurdles clearly exist. A valuable approach would be to attempt to clarify the structural components involved - for example, distinguishing aspects of service network authorisation from the granting of detailed frequency usage assignments. A first step in this process might be to examine common technical factors in the assignment process.

Proposed position

As a contribution to possible rationalisation of national regulatory procedures for authorising operation of mobile service networks with radio infrastructure, a valuable preliminary step would be agreement on common sets of technical and engineering information items needed to support a system operator's request for assignment of frequencies.

Cross-border radio infrastructures

244 For PMR operators, planning self-provided networks, restrictions on the ability to extend radio coverage across national borders would seem more significant - as this could prevent support for business activity which spanned borders by a single closed network for communication across the same territory.

245 For some simple PMR applications, the harmonised introduction over the next few years of DSRR short range radio capabilities and terminals (following the March 1993 ERC Decision on common frequencies) will allow operations without the need for individual frequency assignments. This will include cross-border operations, although communication range will generally be limited to a few kilometres.

246 Greater opportunities for co-ordinated frequency management for other PMR bands in border areas may depend on the prospects for pan-European harmonised allocation for this use which can be proposed through the ERO Detailed Spectrum Investigations; the prime need is likely to be at frequencies below 1GHz, and this will be addressed within the current DSI over the next two years.

247 As part of coordination procedures to avoid harmful cross-border interference, there already exist a number of bi-lateral and multi-lateral agreements between neighbouring countries in Europe concerning preference rights for frequency assignments in border regions - covering a range of defined services and spectrum sub-bands. These schemes typically partition the planned channels for the relevant service between the bordering administrations (possibly more than two in complex regions). The current DSI will be considering whether a generalised frequency coordination procedure should be established for border areas of all CEPT countries.

248 If PMR operators were to request operational authorisation and frequency licensing in a number of countries, they would be assisted by a clearing house function which could provide a central point of contact for routing requests to national administrations and coordinating the response from national assignment procedures. The ERO (or a similar permanent office supporting ECTRA) could form a suitable base for such a function, and suggestions already exist for it to develop such a role in other cases, for example in connection with VSAT station licensing.

249 The variety of frequency licensing procedures employed in European countries, as already noted, would present practical difficulties for multiple national licensing requests, despite any central clearing house facilities. Spectrum regulators have suggested that inter-administration cooperation on the technical process of frequency assignments for any suitable

applicant could be developed - as already demonstrated in agreements on coordination to avoid harmful interference. Particularly within pan-European harmonised allocations, this aspect need not present a fundamental barrier to facilitating authorised cross-border operations.

Proposed position

Particularly in the context of self-provided networks for private mobile radio service, the EC should seek development of regulatory approaches which would enable authorisation of mobile network operation with planned cross-border radio propagation and service coverage.

Proposed actions for the CEC

- **The CEC should consider placing work requests:**
 - on ERO to identify, for a range of mobile radiocommunications service types, common sets of technical/engineering information elements necessary to support an assignment of frequencies for use with relevant network systems - suitable as guidelines for common practice in member state procedures for assignment;
 - on ETO to propose a regulatory approach for authorising cross-border operation of PMR networks in the EC.

APPENDIX I: Global Framework for Spectrum Management

The Appendix is separately bound from this report.

APPENDIX II: Glossary

- Allocation** (of a frequency band) a frequency band entered in the Table of Frequency Allocations, for use by one or more terrestrial or space radiocommunications service, or the radio astronomy service, under specified conditions. Term may also be applied to the frequency band itself.
- Allotment** (of a radio frequency or radio frequency channel): Entry of a designated frequency channel in an agreed plan, adopted by a competent conference, for use by one or more administrations for a terrestrial or space radiocommunication service in one or more identified countries or geographical areas and under specified conditions (RR18)
- Assignment** (of a radio frequency or a radio frequency channel) authorisation given by a licensing authority for a radio station to use a radio frequency or channel under specified conditions. Note: the assigned frequencies will have been chosen from a part of the spectrum that is technically suitable for the user's purpose and from a frequency band that has been designated for the use of stations in the service category of the licensed station.
- Frequency Planning Organisation**
an organisation which undertakes administrative and technical tasks of management of part of the radio frequency spectrum
- Mobile Service (MS)**
comprises stations which operate whilst moving or when at rest at unspecified points, and the stations, fixed or mobile, with which they communicate. If these communication links are relayed at a satellite, then the mobile earth stations and the associated space stations are part of the **mobile-satellite service (MSS)**. In addition to these general categories three specialised categories have been created in the MS and MSS for maritime, aeronautical and land mobile stations. A station on an aeroplane, operating without the use of a satellite, can be considered as part of either the MS or the aeronautical mobile service and an earth station on a ship and the associated space station can be considered as part of either the MSS or the maritime mobile-satellite service.
- Permitted Service**
a service which has equal rights to primary service except that, in the preparation of frequency plans, the primary service has prior choice of frequencies
- Primary Service**
a service which has first choice of frequencies and may claim protection against harmful interference from a secondary service
- Secondary Service**
a service which cannot claim protection against stations of a Primary or Permitted service to which a frequency band is also allocated
- Service (ITU categorisation)**
There are 38 ITU categorised services including Fixed service; fixed satellite service; aeronautical fixed service; broadcasting service; broadcasting-satellite service; mobile service; mobile-satellite service; amateur service; amateur-satellite service; plus a number of technical/scientific services and radionavigation/radar services.

APPENDIX II: Abbreviations

AMPS	Advanced Mobile Phone System
ARFA	Allied Radio Frequency Agency
APC	Aeronautical Passenger Communications
BDT	Telecommunications Development Bureau
B-ISDN	Broadband Integrated Services Digital Network
BMPT	Bundesministerium für Post und Telekommunikation (Germany)
BTCE	Bureau of Transport and Communications (BTCE)
CEC	Commission of the European Communities
CERP	European Committee on Postal Regulations
CEPT	Conference of European Postal and Telecommunications Administrations
CCIR	Consultative Committee on International Radio
CCITT	International Telegraph and Telephone Consultative Committee
CITEL	Inter-American Telecommunications Conference
DBT	Deutsche Bundespost Telekom (Germany)
DECT	Digital European Cordless Telecommunications
DOD	Department of Defence
DRG	Direction de la Réglementation Générale (France)
DSI	Detailed Spectrum Investigation
DSRR	Digital short range radio
DTI	Department of Trade and Industry (UK)
EC	European Community
ECTEL	European Telecommunications and Professional Electronic Industry
ECTRA	European Committee for Telecommunications Regulatory Affairs
EEA	European Economic Area
EFTA	European Free Trade Association
EMVG	Electromagnetic Compatibility Act (Germany)
ERMES	European Radio Messaging System

ERO	European Radiocommunications Office
ERC	European Radiocommunications Committee
ETACS	Extended Total Access Communications System
ETCO	European Telecommunication Consultancy Organisation
ETNO	European public Telecommunications Network Operators' association
ETO	European Telecommunications Offices
ETR	European Technical Report
ETSI	European Telecommunications Standards Institute
FCC	Federal Communications Commission (US)
FPLMTS	Future Public Land Mobile Telecommunication Systems
GLONAS	Global Navigation Satellite
GSM	Groupe Special Mobile/Global System for Mobile
GSO	Geo Stationary Satellite
HLC	High Level Committee (ITU)
IFRB	International Frequency Registration Board (ITU)
INMARSAT	International Maritime Satellite
IRAC	Interdepartment Radio Advisory Committee (US)
ISM	Industrial Scientific and Medical
ITU	International Telecommunication Union
LEO	Low Earth Orbit (satellite)
MoU	Memorandum of Understanding
MPT	Ministry of Posts and Telecommunications (Japan)
MSS	Mobile Satellite Service
NATO	North Atlantic Treaty Organisation
NMT	Nordic Mobile Telephony
NPRM	Notice of Proposed Rule Making
NRA	National Regulatory Authority
NTIA	National Telecommunications and Information Administration (US)

OECD	Organisation of Economic Cooperation and Development
ONP	Open Network Provision
PCN	Personal Communication Networks
PAMR	Public Access Mobile Radio
PCS	Personal Communication Services
PLMR	Private Land Mobile Radio
PMR	Private Mobile Radio
PSTN	Public Switched Telecommunications Network
RA	Radiocommunications Agency (UK)
RACE	Research and development in Advanced Communications technologies in Europe
SINGARS	Single Channel Ground to Air Radio
SMA	Spectrum Management Agency (Australia)
SMG	Special Mobile Group (ETSI)
TACS	Total Access Communications
TDMA	Time Division Multiple Access
TETRA	Trans European Trunked Radio
TFTS	Terrestrial Flight Telecommunications System
WARC	World Administrative Radio Conference
UMTS	Universal Mobile Telecommunications System
UHF	Ultra High Frequency
VGE	Voluntary Group of Experts (ITU)
VHF	Very High Frequency
VSAT	Very Small Aperture Terminal

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