This document provides the Results of the Detailed Spectrum Investigation Phase II covering the spectrum between 29.7 and 960 MHz. This Investigation was conducted amongst the countries which are members of the European Conference of Postal and Telecommunications Administrations (CEPT).

The document was presented to the European Radiocommunications Committee and CEPT administrations on 13 March 1995. The Committee has agreed that the Results be published but it should be noted that the contents, including assumptions, forecasts, conclusions and recommendations do not necessarily represent the views of CEPT, the ERC or Administrations.

The Results of the Detailed Spectrum Investigation Phase II will be subject to public consultation[*] during 1995. The CEPT and the ERC hope to give an initial response with respect to the Recommendations by August 1996 and to publish its final position in Spring 1997.

[*] Potential contributors to the public consultation process are requested to refer to Annex K to this document. Comments delivered to the ERO by 29 September 1995 will be given full consideration. If however additional time is required, contributors are invited to contact the ERO.

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Contents

EXECUTIVE SUMMARY OF THE SECOND PHASE OF THE DETAILED SPECTRUM INVESTIGATION (DSI) 29.7-960 MHz

Introduction (Chapters 1 and 2)

The second phase of the Detailed Spectrum Investigation (DSI) was launched by the European Radiocommunications Committee (ERC) of the Conference of European Postal and Telecommunications administrations (CEPT) in March 1993 with terms of reference as follows:

To investigate the current and foreseen use of the radio spectrum in CEPT countries in the frequency range 29.7 MHz to 960 MHz and the way it is currently managed and administered; to produce a detailed document addressing the issues which shall include, as appropriate, recommendations to the ERC of the CEPT.

A principal objective of the DSI process is to establish a European Table of Frequency Allocations and Utilisations. A proposed Table covering this phase of the DSI is to be found at Annex A to this Results Document. It is intended that this Table be implemented by the year 2008, however it may be possible to implement some proposals somewhat earlier whilst some recommendations may require additional time. A list of the recommendations of the DSI Management Team follows this executive summary (see pages 10-18).

Spectrum Management and the Environment (Chapters 3, 4, 5, 6 and 12)

The radio spectrum is an important natural resource and has an increasing influence on the economy of Europe. The management of the spectrum at both the national and European level is a complex matter, but the DSI Management Team strongly believes that the rewards to be gained from harmonisation necessitate that every effort be made to align European procedures wherever feasible.

Considerable debate has ensued on the regulatory mechanisms in Europe for allocating frequency bands i.e. ERC Decisions and the method of redistributing spectrum from existing users to new users requiring access to frequencies. The DSI Management Team has suggested a number of measures to facilitate the situation; spectrum for new applications should be determined at the European level by an objective evaluation process supported by market analysis, backed up by a procedure which obtains a commitment from all interested parties (administrations, users, service providers and industry) and reduces the financial burden on users required to vacate spectrum. The timely availability of equipment standards is also considered extremely important and thus the development of improved working arrangements with CENELEC, ETSI and relevant organs of the EC is fully supported.

The DSI Management Team also supports the recommendation of the first phase DSI that all users of the radio spectrum should contribute financially to

the efficient management of the spectrum resource and the direct and indirect costs of administration should be recovered from licensees.

However, the introduction of market forces to the spectrum management process is not supported, since if other DSI recommendations are implemented it is not obvious that there are likely to be significant spectrum shortages. Instead a differential licensing philosophy is proposed in order to recover the costs of spectrum management. This is outlined in detail in Chapter 12 of the Results document.

Broadcasting (Chapter 7)

In addition to the actual transmission of television and sound programmes, a significant amount of spectrum is required for services ancillary to broadcasting (SAB) to support the making of programmes. Broadcasting in forthcoming decades will be dominated by the 'digital revolution', which in addition to offering broadcasters and programme makers a considerable number of new opportunities in a multimedia environment, also offers the possibility for long term spectrum savings and/or additional programming.

To facilitate the development of terrestrial digital audio broadcasting (T-DAB) providing CD quality to portable and mobile equipment, the DSI Management Team has proposed a new permanent frequency allocation 216-240 MHz (possibly supplemented by a band at 1.5 GHz) to be implemented once the T-DAB introductory phase has been completed. It is however believed that an FM broadcasting band may still be required for local and community broadcasting and the band 97.5-108 MHz is recommended as the eventual frequency limits for broadcasting Band II to support future FM transmissions. This spectrum solution may not be fully implemented until the year 2020 in order to allow the simultaneous broadcasting of T-DAB and FM transmissions in the transition period.

Concerning digital terrestrial television broadcasting, the DSI Management Team supports an early commencement of digital television broadcasting in view of the potential spectrum savings to be achieved following the transitional period. To achieve this it is believed that spectrum in the band 470-862 MHz should be made fully available for broadcasting in the short term and the extension of analogue television networks should cease immediately. Such a scenario is required to facilitate the continuation of existing analogue transmissions and allow the introduction of new digital services in a 20 year or more transition period. The DSI Management Team therefore urges CEPT administrations to take all practical steps to clear Band I of assignments to the broadcasting service, starting from the lower end, in order to make possible the introduction of alternative services in the band 47-54 MHz by the year 2008. Following the transition period currently envisaged to be post 2020, subject to review, the bands 174-216 MHz and possibly 470-510 MHz should be considered for non-broadcasting services.

Proposals have been made to improve the arrangements for SAB operations by harmonised frequency allocations and equipment parameters together with improved administrative procedures.

Land Mobile Service (Chapter 8)

Public mobile radio services which are considered as extensions to the fixed network will focus in future on the 900 MHz range. The DSI Management Team has recommended that two additional 10 MHz sub-bands be made available for an extension to the global digital GSM mobile system. It is also recommended that analogue public mobile networks be closed down by the year 2008.

Non-public mobile radio systems have been classified generically as professional mobile radio (PMR). Service provided PMR will be implemented with systems utilising European TETRA technology and a total of 40 MHz is recommended to be harmonised on a European basis by the year 2008, with 20 MHz coming from the band 380-400 MHz and the remainder being chosen from sub-bands within the bands 410-430 MHz and 450-470 MHz.

All categories of PMR are anticipated to require a minimum total of 115 MHz in the major European conurbations. This estimate takes account of technological developments likely to occur in the next 15 years. However experience might prove this figure to be inaccurate and periodic reviews at 5 year intervals are recommended by the DSI Management Team. Provisions for wide area and on-site paging and wireless local loop systems are also addressed in Chapter 8.

Defence (Chapter 9)

Defence is a major user of spectrum below 960 MHz. On average 30% of spectrum is used for this application as compared with broadcasting which on average utilises 40% of available frequencies.

A major factor in developing a future European Frequency Table is to provide spectrum resources where it is geographically required. This policy requires that urgent attention be given to the development of appropriate sharing scenarios, since the DSI Management Team believes that in peace time a significant amount of geographical sharing should be feasible between defence and civil land mobile applications. It is additionally recommended that the band 240-380 MHz should become a core band for defence space radiocommunications, air-ground-air and radiolocation applications in the DSI Phase II frequency range. The recommendations of the DSI Management Team concerning defence would have the effect of freeing additional spectrum above 60 MHz where there is an urgent need to provide more frequencies for civil land mobile services.

Other Services (Chapter 10)

A number of other services and applications have been considered by the DSI Management Team and where appropriate recommendations made. These include proposals to limit the fixed service below 960 MHz, changes and additional frequency allocations for the amateur service, aeronautical and

maritime mobile services where the introduction of new technology has been considered. Radio Astronomy and space radiocommunication services have also been addressed and proposals to implement low earth orbiting mobile satellite systems developed.

However one of the most important applications addressed in Chapter 10 is the question of frequencies for low power devices. In addition to a consideration of ISM allocations, new bands are proposed at 138-142 MHz, 403-404.5 MHz and 915-919.5 MHz for general low power applications on a European basis, which it is hoped will encourage harmonisation and eventually alleviate some of the problems experienced in the use of existing allocations. Frequencies for model aircraft, cordless telephones and cordless microphones are also discussed and frequency solutions offered.

Miscellaneous (Chapters 11 and 13)

Chapter 11 addresses a number of key issues identified prior to, or during the DSI process. The DSI Management Team in particular supported the view that as a general principle ETSI decisions concerning technology issues should not be re-opened and as a logical extension to a common European Frequency Table, a detailed co-ordination process be established in European border areas by extension of the Vienna Agreement and other similar regulatory mechanisms. The CEPT ERC Decision concerning the DSRR (digital short range radio) system is proposed for abrogation in view of its limited support. Lastly in Chapter 13 a review of relevant recommendations from DSI Phase I (3.4-105 GHz) has been conducted.

Recommendations

GENERAL

1. In order to meet the objective of a European Table of Frequency Allocations and Utilisations the proposed Table at Annex A to this document should be incorporated as soon as possible into ERC Report 25 with a view to the future transfer of this Report into an ERC Recommendation or Decision. (Section 3.8)

2. To encourage compliance with CEPT ERC Decisions and to seek a commitment from all interested parties the DSI Management Team recommend:

- the development of objective criteria to determine suitable frequency bands for new requirements. Such criteria should be based on the existing economic investment and occupancy of the candidate spectrum,
- that all new major requirements shall be the subject of market analysis before a decision is taken to allocate spectrum,
- that all involved parties shall be invited to commit themselves to the timetable by signature of an agreed position statement,
- the continuation of the ERC Decision process for major European projects involving spectral resources,
- that administrations initiate the administrative procedures necessary to free spectrum within the required time frame following their commitment to an ERC Decision,

  The following is a process the DSI Management Team would recommend for further consideration in the commitment process:
- that the transfer of existing professional radio users from a frequency band which is required for a new application in the short term (within 10 years) be jointly funded by interested parties for example industry and operators (where appropriate) of the new system to a value based on a standard costing formula to be developed at the European level,
- that licensing would be conditional on successfully concluded negotiations,
- that CEPT administrations be encouraged to introduce incentive licensing regimes to encourage such transfers,
- that a timetable for each major spectrum refarming project be established on a European basis which shall be determined by consensus with all involved parties but in particular with administrations, equipment manufacturers and operators (where appropriate) of the new system,
- that the timetable mentioned above shall contain a date which shall be confirmed by all parties after which the transfer process of existing users shall be initiated. (Section 4.4)

3. CEPT administrations that have not already actioned the relevant DSI Phase I recommendation should reflect the direct and indirect costs of spectrum management in licence fees and charges to all spectrum users, including those still retaining monopoly privileges. (Section 12.9)

4. Studies already in progress on establishing licence fee structures within CEPT countries should be accelerated and the elements which are used to formulate fees should be harmonised on a European basis.
In order to facilitate the spectrum management process in CEPT countries the following policy guidelines are also recommended by the DSI Management Team:

- in general radio licensing policies for assigning radio frequencies and authorising radio systems should continue on a 'first-come, first-served' basis with appropriate consideration and responsiveness to new service demands and overall objectives,
- once radio systems have been licensed, administrations should ensure that they are implemented within a reasonable time and radio frequencies are efficiently utilised,
- where existing users have to be transferred to alternative spectrum, the refarming strategy and compensation mechanism recommended in Section 4.4 be implemented, the incentive licensing element to be considered part of the overall fee criteria,
- for competitive licensing, where the available spectrum is inadequate to satisfy all demands, or where it is necessary to limit the number of new entrants, the administrative comparative approach (beauty contests) should be used to select licensees from qualified applicants,
- if other market based approaches are eventually considered necessary, an appropriate mechanism should be established after full public consultation, preferably on a European basis,
- the radio spectrum should continue to be managed by agencies (see section 13.8) directly responsible to government Ministers but delegated responsibility for planning and frequency assignments could be considered for specialised user groups, for example police and fire, defence, ancillary broadcasting etc. where such delegation is seen to be in the public interest,
- emphasis should be placed on efficient spectrum utilisation, by applying adequate planning techniques and spectrum efficient technologies,
- the research and development of efficient spectrum usage should be encouraged. (Section 12.9)

5. ETSI decisions should not be re-opened without extremely good reason. In order to make the best use of industrial and standards organisations' resources it is additionally recommended that advocates of new technologies should in parallel with national considerations input ideas into the European fora to gauge their acceptability. Ideas that have been formally considered and rejected in ETSI should not be resurrected in ETSI unless there are obvious changes in the telecommunications environment which would indicate a change in policy is justified. (Section 11.5)

6. The Vienna Agreement and other similar Agreements already in place within CEPT countries should be studied with a view to implementing a harmonised detailed co-ordination process in border areas for terrestrial radio services operating between 29.7 and 960 MHz. (Section 11.13)

ENVIRONMENTAL ISSUES

7. CEPT administrations who are also Member States of the European Union should press for a review of Article 10.5 of the EMC Directive to propose that the Directive applies to non radio aspects only. Further, the EC marking of radiocommunications equipment should only be possible when the equipment conforms to an appropriate European regulation, e.g. an EU Directive or a CEPT ERC Decision allowing for the free placing of such equipment on the market. (Section 6.1)

8. CEPT administrations should actively lobby concerned agencies within their countries to develop a European standard covering electromagnetic radiation which should include power density limits, safe distances and maximum exposure times. (Section 6.2)

SOUND BROADCASTING

9. The frequency range 216-240 MHz should be allocated to Digital Audio Broadcasting in accordance with the following conditions:

- 216-230 MHz core band for terrestrial DAB. The band 216-223 MHz to be shared with analogue terrestrial television during the transition period to digital television in the UHF bands
- 230-240 MHz sharing with military in time of crises

It is additionally recommended that if necessary, 10 MHz in the band 87.5-108 MHz should remain for FM broadcasting to cater for a residual requirement for community and local radio services. (Section 7.2.4)

10. The following scenario for the introduction and development of DAB is recommended noting that a decision to hold a CEPT terrestrial DAB Planning Meeting in July 1995 has already been taken:

	1995	CEPT planning meeting
from	1996	introduction of DAB
	1999	proposal to WRC-99 to additionally allocate the band 230-240 MHz to the broadcasting service and a footnote indicating that the band 216-240 MHz is intended for terrestrial DAB.
	2005	ITU planning conference for -planning DAB in the band 216-240 MHz and at 1500 MHz -revision of Geneva Agreement 1984 -planning the withdrawal of FM services -replanning the remaining FM services
from	2008	phasing out of FM and extending DAB
from	2020	87.5- 97.5 MHz to be available for other services

It is further recommended that this scenario and timetable be reviewed periodically in the light of any developments in the coming decades. (Section 7.2.4)

TELEVISION BROADCASTING

11. During the transition period from analogue to digital television broadcasting, it is recommended that the entire frequency range 470-862 MHz be utilised for digital television provided that any channels that may become available in the short and medium term are not used for extending the analogue broadcasting network(s). Where possible television transmissions in the frequency range 47-68 MHz should cease. (Section 7.3.9)

12. Where feasible the frequency band 47-68 MHz should be immediately allocated to other services and the other broadcasting bands used for television should be reviewed during the transition period. The band 174-216 MHz is a prime candidate for consideration. Subject to future decisions on broadcasting and land mobile policies, the band 470-510 MHz may also be a candidate for reallocation. (Section 7.3.9)

13. The following scenario for the introduction and development of digital television is recommended:

early	1997	planning parameters approved
early	1998	CEPT planning meeting for the introduction of digital television
end	1998	introduction of digital terrestrial television
	2005	ITU planning conference for the: -determination of the future requirements for terrestrial digital television -revision of the Stockholm Agreement 1961 -planning the withdrawal of analogue services
from	2008	phasing out of analogue television
from	2020	subject to review, possible use of the band 174-216 MHz and perhaps also 470-510 MHz for other services.

It is further recommended that this scenario and timetable be reviewed periodically in the light of developments in the coming decades. (Section 7.3.9)

SERVICES ANCILLARY TO BROADCASTING

14. Every effort should be made to harmonise SAB frequency allocations and equipment parameters. (Section 7.4.5)

15. When the use of broadcasting spectrum is not feasible, the bands primarily identified for defence applications might be considered for SAB on a pre-emptive basis, with geographical constraints as necessary. (Section 7.4.5)

16. Following the transition from analogue to digital broadcasting, the future bands to be used for broadcasting should only be shared with services ancillary to broadcasting. (Section 7.4.5)

17. National SAB structures should be established to monitor, co-ordinate and rapidly respond to SAB requirements. Further, arrangements should be instigated to meet the needs of SAB users crossing national borders. The DSI Management Team recommend that the ERC consider in due course, the establishment of a joint CEPT/EBU SAB forum. This combined forum should manage the dynamic process of allocation and reallocation of SAB frequency bands and assignments, monitor the overall requirement for SAB and advise on all other regulatory and operational aspects in relation to the successful operation of SAB in Europe. (Section 7.4.5)

MOBILE SERVICE

18. The harmonisation of professional mobile radio networks' regulations, including spectrum allocations, should be considered as a matter of priority and urgency by the ERC. (Section 8.2.2)

19. A minimum of 115 MHz of spectrum should be available for PMR in the major conurbations of Europe. (Section 8.2.5)

20. The band 380-400 MHz should be designated for TETRA together with other sub-bands, within the bands 410-430 MHz and 450-470 MHz, on a European basis. (Section 8.2.6)

21. An in depth study should be conducted as soon as possible concerning the possibilities likely to occur for PMR and other non public mobile applications through the decreasing use of the 450 MHz range for public mobile networks. (Section 8.3)

22. Analogue public mobile networks should be closed not later than 2008. (Section 11.3)

23. CEPT ERC Recommendation T/R 75-02 should be revised and a new CEPT ERC Decision be prepared which designates the frequency bands 880-890 MHz paired with 925-935 MHz on a European basis, as extension bands for the GSM digital pan-European communication system. (Section 11.16)

24. CEPT ERC Decision ERC/DEC/(93)01 should be abrogated after discussions with ETSI concerning the future of the DSRR standard. (Section 11.17)

25. WLL systems in urban areas should preferably be based upon standards utilising frequency bands above 1 GHz, e.g. standards which are developed for the 3.4 GHz band. (Section 8.5.8)

26. The allocation to the aeronautical mobile (OR) service should be removed from the band 142-144 MHz. (Section 10.5.5)

27. The DSI Management Team recommend that CEPT administrations

- introduce a 4.6 MHz base/mobile station transmit separation in the band 156-165.2 MHz in accordance with Annex 2 of Recommendation T/R 25-08,
- provide improved protection for the international maritime mobile service through appropriate measures within CEPT and relevant proposals to WRC 97,
- consider the designation of the bands 157.45-157.95 MHz paired with 162.05-162.55 MHz for European private maritime applications in coastal areas and along inland waterways utilising 5 or 6.25 kHz channel spacing, recognising that these bands should also be available for land mobile purposes where such use does not affect the maritime service,
- in preparation for WRC-97 and a review of Appendix 18 and in order to provide a market for reduced channel spacing maritime equipment, develop proposals to introduce 5 or 6.25 kHz channel spacing on a global basis for all new maritime installations as soon as possible, recognising that a full changeover will not be feasible for many years,
- It is further recommended that the sub-band 160.975 to 161.475 MHz be examined for its suitability for general single frequency applications e.g. wide area paging, low power devices or services ancillary to broadcasting. (Section 10.7.3)

LOW POWER DEVICES

28. The band 48.5-49.5 MHz should be used as the main on-site paging band in accordance with the existing CEPT Recommendation T/R 02-01 and from within the band 403-404.5 MHz, 5 call-out and 5 talk-back frequencies should be chosen by Working Group FM to be introduced on a co-ordinated and harmonised basis. (Section 8.4.1)

29. The DSI Management Team recommend that:
- the different terms used in CEPT Recommendations and ETSI Standards for low power applications be harmonised.
- protected channels for the control of model aircraft within the band 34.995-35.225 MHz be agreed.
- a general low power application band at 138.00-142.00 MHz be agreed.

- an allocation be agreed for a general low power band at 403-404.5 MHz intended for new applications and to avoid placing new equipment at 433 MHz unless absolutely essential, the 433 MHz band to be subject to a general review at an appropriate time.
- a general low power application band at 915-919.5 MHz be allocated. (Section 10.10.1)

30. Any national solutions being considered for LPDs should be fully debated within CEPT before any definitive decision is reached. Such a policy it is believed would benefit the overall European harmonisation project. (Section 11.11)

31. Cordless telephone/telecommunications systems should use frequencies above the DSI Phase II frequency range by the year 2008, preferably utilising the DECT system operating in the frequency band 1880-1900 MHz. (Section 10.10.2)

32. Three bands should be made available for cordless microphones 29.70-34.90 MHz, 174.00-175.50 MHz and 862-875 MHz. The band 174.00-175.50 could already be available in some countries but may only become generally available following the transition from analogue to digital TV broadcasting. (Section 10.10.3)

DEFENCE

33. In respect of defence spectrum usage, the DSI Management Team recommend that in all CEPT countries, major efforts should be expended on developing a spectrum management regime which is designed to provide on the basis of requirements, additional spectrum for land mobile applications in the conurbations of Europe. As a general rule, in peace time, almost all of spectrum within bands identified for two frequency mobile systems should be available, if required, for civil systems in major urban areas, such as Frankfurt, London, and Paris.

Conversely, in the bands mentioned in the previous paragraph, where there is a defence requirement, almost all of the spectrum should be available in geographical locations where harmful interference would not be caused to civil systems utilising the same spectrum in the conurbations. A different ratio of spectrum availability should apply in times of crisis and civil systems must be designed with this criteria in mind. (Section 9.8)

34. Negotiations should continue concerning the release of the remaining 10 MHz of the spectrum in the band 380-400 MHz for use in the conurbations, and defence authorities should as soon as possible determine their longer term air-ground-air, radio relay and radiolocation/radionavigation requirements in the band 240-380 MHz. (Section 9.8)

35. Further sharing possibilities be actively explored, especially the accommodation of low power devices in defence bands, in particular the band 403-404.5 MHz should be available for low power devices. (Section 9.8)

FIXED SERVICE

36. The allocation of frequencies to the fixed service in the 29.7-960 MHz band should be progressively reduced until it is eliminated in the long term; in particular cases, as a national solution for remote and rural areas, licensing of fixed links should be permitted with secondary status only. Such fixed links should contain no more than 1 telephone channel or equivalent. (Section 10.1)

AMATEUR SERVICE

37. The DSI Management Team recommend that:

- the band 50-52 MHz be allocated to the amateur service on a primary basis, the band 51-52 MHz additionally to be allocated to the mobile service;
- frequencies in the vicinity of 40.68 MHz be considered for amateur propagation beacons;
- a minimum of 100 kHz in the band 70-70.45 MHz be allocated to the amateur service on a secondary basis according to national considerations, if feasible, centred on 70.2 MHz;
- the band 144-146 MHz be maintained with its current status;
- the band 430-440 MHz be reduced to 432-438 MHz with primary status for the amateur service. The band 435-438 MHz to be allocated to the amateur satellite service on a primary basis. It is additionally recommended that the 433 MHz ISM and low power band be reviewed after an appropriate time period to ascertain whether alternative arrangements for ISM and low power render its retention unnecessary;
- the band 919.5-920 MHz be allocated to the amateur service on a secondary basis.
- It is further recommended that the regulatory issues outlined in section 10.4.4 be addressed by the appropriate constituent body of the ERC. (Section 10.4.5)

MOBILE SATELLITE SERVICE

38. The Management Team recommend that CEPT administrations urgently address the market potential and their national requirements for 'little LEO' systems. The policy and priorities concerning 'little LEOs' and existing services should be developed in particular for the band 148-150.05 MHz but also a position for the bands 137-138 MHz and 400.15-401 MHz is required. If 'little LEO' systems are found to have sufficient priority it is further

recommended that a timetable be established for transferring existing services from this band(s) or identifying alternative bands which might be more appropriate for use in CEPT countries, recognising the complications that would arise in utilising different frequency bands in Europe to those used in other regions of the world. (Section 10.6.5)

METEOROLOGICAL AIDS SERVICE

39. Weather sonde systems operating in the 400.15-406 MHz band should be moved gradually to the 1.7 GHz band. (Section 10.9.3)

40. A band of around 1.6 MHz in the vicinity of 50 MHz should be allocated to the met' aid service to provide for the introduction of long range wind profilers. It is further recommended that an allocation for met' aids be introduced in the band 915-920 MHz to provide for narrow band wind profilers. (Section 11.14)

ISM

41. Administrations should take all practicable steps to minimise the radiation from ISM equipment and should ensure that any out of band radiation does not cause harmful interference to any radiocommunication service operating in adjacent bands. (Section 10.11.3)

1. Introduction

1.1 Background

This document provides the results of the second phase of the Detailed Spectrum Investigation (DSI) conducted by the European Radiocommunications Office (ERO) on behalf of the European Radiocommunications Committee (ERC) of the European Conference of Postal and Telecommunications Administrations (CEPT). The CEPT is the regional telecommunications organisation for Europe and at 1 March 1995 comprised 42 member countries. During 1994 the Russian Federation became the fortieth member of the CEPT. In view of the importance of Russia in terms of history, size and industrial base, it is unfortunate that the timing and logistics of the DSI second phase has not facilitated contributions from that country. It is hoped that the public consultation exercise which will take place during 1995 will rectify this situation to some extent.

The ERC brings together the radio regulatory authorities of the CEPT administrations and at its meeting in June 1991 it was decided that the ERO should embark upon a European spectrum audit, the DSI process. The first phase covered the range 3400 MHz to 105 GHz, the results of which were published in March 1993 with the ERC providing its final response to the various recommendations in April 1994. This second phase of the DSI process was launched in March 1993 with a request for contributions by February 1994. The results of the second phase were presented to CEPT administrations and the ERC at its meeting in March 1995.

1.2 CEPT and the ERC

The CEPT is the European organisation which deals with regulatory issues concerning posts and telecommunications. It has three committees reporting to the CEPT Plenary, CERP dealing with postal matters, ECTRA concerning general telecommunications regulation and the ERC which addresses radiocommunications issues of a regulatory and administrative nature. Within this mandate the ERC is particularly concerned with the management of the radio frequency spectrum; the members of the ERC are the radio regulatory administrations of the CEPT countries.

The ERC meets three times a year but the detailed work is delegated to project teams, the four permanent working groups or the ERO, the ERC's permanent office and resource in Copenhagen. The ERO was established in 1991 to provide a focal point for consultation, long term spectrum studies and support of the on-going work in the ERC and its other constituent bodies. The structure of the ERC is included at Annex E to this document.

Turning then to the permanent working groups of the ERC. The Frequency Management (FM) working group has amongst its tasks the development of spectrum strategies, the harmonisation of frequency allocations and provides an appropriate forum to facilitate discussions between CEPT's frequency managers. The Radio Regulatory (RR) working group studies legal, regulatory

and administrative matters and seeks to harmonise licensing and type approval procedures. The Spectrum Engineering (SE) working group develops guidelines for the optimal use of frequency bands, develops sharing criteria between different radio services based on compatibility studies and reviews equipment parameters which are important for the management of the radio spectrum. SE also provides the principal interface between the European Telecommunications Standards Institute (ETSI) and the ERC.

The Conference Preparatory Group (CPG) has the task of co-ordinating preparations for the International Telecommunication Union (ITU) World Radio Conferences (WRC) and ITU Radio Assemblies and is responsible for the preparation and approval of the CEPT brief and European Common Proposals (ECPs). The ERC has established in co-operation with ECTRA a joint ITU Group to co-ordinate preparations for ITU Council meetings and Plenipotentiary Conferences. The FM, RR and SE working groups prepare draft output documents (see section 1.3. below) for consideration and subsequent approval by the ERC.

In addition to the ITU a number of other organisations have a significant impact on European spectrum management considerations and the ERC's relationship with some of the key players is addressed further in chapter 5 of this document.

1.3 CEPT Output concerning the Band 29.7 to 960 MHz

In addition to conference proposals (ECPs), CEPT ERC Decisions, Recommendations and Reports are also produced. Decisions are measures approved by the ERC on significant harmonisation matters (see section 4.1). CEPT ERC Recommendations are measures approved by the ERC which administrations are encouraged to apply and are intended as harmonisation measures for those matters where Decisions are not yet relevant. CEPT ERC Reports are the result of studies by the ERC or its constituent bodies, normally in support of a harmonisation measure.

A considerable amount of CEPT's recent work in the radiocommunications field has resulted in output documents addressing frequencies or systems operating in the second phase DSI frequency range. Since in most cases this represents a significant harmonisation achievement, the DSI Management Team paid close attention to existing documentation and where appropriate reflected relevant harmonisation results into the proposals and recommendations of the DSI. For the information of readers the relevant Decisions and Recommendations are detailed at Annex G to this document. CEPT ERC Decisions, Recommendations and Reports can be purchased from the ERO or the CEPT Liaison Office, further details are provided in Annex G.

1.4 DSI Objective

The DSI process has as an overall objective to ensure that European administrations, industry, broadcasters, service providers, operators and

users derive maximum benefit from the radio spectrum, a limited natural resource. This document detailing the second phase of the DSI includes a series of recommendations to be considered by the ERC. A principal objective of the DSI process is to facilitate a European Table of Frequency Allocations and Utilisations to be implemented by the year 2008. This year should however be seen as a general aim. Some of the findings may be implemented earlier than 2008. In other cases developments may have to be implemented somewhat later.

The terms of reference for the second phase of the DSI are as follows:

To investigate the current and foreseen use of the radio spectrum in CEPT countries in the frequency range 29.7 MHz to 960 MHz and the way in which it is currently managed and administered; to produce a detailed document addressing the issues which shall include, as appropriate, recommendations to the ERC of the CEPT.

The DSI should take account of the operational needs of existing users, the obligations imposed by international treaties and agreements, the impact of technological developments and the availability of economic and other resources to implement changes. Further, European industry, commerce and users should be consulted concerning future spectrum requirements.

2. Method of Work

2.1 Invitations to Contribute

The second phase DSI was launched in March 1993 through an ERO Press Release (18 March 1993) and ERO Newsletter No. 8. During April and May 1993 around 350 individual invitations to contribute to the investigation were sent to a number of companies and organisations. A deadline of the end of February 1994 was given for the inputs.

2.2 Management Team

In October 1993 the ERC nominated the Management Team for this DSI as follows:

ERC Members	External Members
David Court, ERO, Chairman	Ian Laybourn, MRUA
Yves Mongelard, ERO	Jan Doeven, EBU
Pasi Toivonen, ERO	Joseph Gelas, ECTEL
Thormod Bøe, Chairman WG FM	Wolfgang Schiever, ETNO

In addition secretarial support was provided by Blaza Johansen of ERO.

Due to Mr Bøe's unavailability during autumn 1994 he was temporarily supported by Graham Dolby, vice Chairman WG FM at a number of meetings.

The task of this group was to evaluate the inputs received and consult the contributors when necessary. Consultation meetings were held in Copenhagen and Brussels with industry and NATO.

The first meeting of this group took place in January 1994 and monthly meetings were held from March to August 1994.

During September and up to early November meetings were held every second week.

2.3 Contributions

By the end of September 1994, a total number of 141 input documents were received (21% from administrations, 20% from manufacturers, 19% national organisations/groups, 14% international organisations/groups, 14% operators and 12% users). Annex B shows the list of contributors.

In addition to contributions directly submitted to the DSI, many ERO studies have been used as information documents.

The preliminary results of DSI Phase II were presented to the public at the DSI Seminar during the fourth CEPT Radio Conference in November 1994. The feed back from the seminar was considered by the Management Team and the final results document was presented to CEPT/ERC Working Groups in early 1995 and to the ERC at its 13th meeting in March 1995.

3. Spectrum Matters

This chapter addresses the current situation in CEPT countries, and identifies possible future trends which may have a bearing on how CEPT administrations may develop their regulatory strategies and policies. Radio frequencies have an increasing influence on the economy of Europe; this limited resource is being utilised by an increasing number of large and small industries. In addition the entertainment and broadcasting industry, defence, emergency, leisure and hobby interests have an increasing interest in the regulation (or de-regulation) of the radio frequency spectrum to ensure that the basic resource can be provided in a timely manner for as many operational requirements as possible.

3.1 International Implications

The basic framework for the use of the radio spectrum and the co-ordination of use between sovereign states is the Radio Regulations of the International Telecommunication Union (ITU), a United Nations specialised agency. Individual countries, or groups of countries such as CEPT, take this comprehensive set of rules and develop regulatory procedures which are appropriate for their demographic and economic circumstances. The ERC is actively involved in preparing for ITU activities at most levels and in respect of ECPs concerning the Radio Regulations, the CPG is the forum which establishes CEPT's position on key issues.

Later in the document there will be references to the different geographical Regions mentioned in the Radio Regulations. Regional differences were introduced to permit some flexibility in the way frequency allocations are made. Figure 1 illustrates these divisions; it can be seen that Region 1 comprises Europe, including Russia and other republics which make up the Commonwealth of Independent States (CIS), Africa and the Middle East; Region 2 is north and south America and Region 3 is the remaining geographical areas consisting mainly of Oceania, the Far East and the Pacific sub-region.

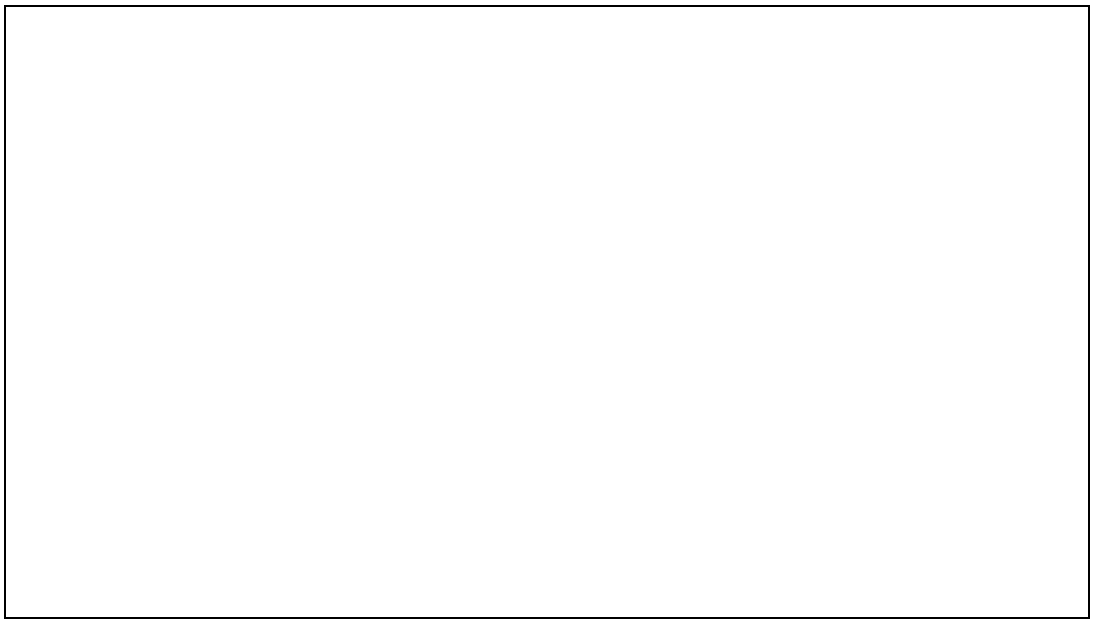

Figure 1.

International trade considerations are gaining increasing importance for the harmonisation of spectrum usage, in order that current and future radiocommunications systems may be implemented, sold and used on a global basis and in this respect the European Union (EU) and the European Commission (EC) have a particular interest (see chapter 5). Such quasi commercial imperatives tend to be reflected back in ITU members' proposals to amend the Radio Regulations, thus it is essential to develop and maintain an effective dialogue with other regional regulatory bodies in order to resolve problems, wherever possible, before they become subject to the rigours of the formal ITU procedures. This is of course rather difficult to realise in practice and may impinge on the administrative, cultural, legal and political traditions of individual countries. However the advantages in developing global markets probably outweigh the many (but nonetheless important) domestic political issues which are likely to arise.

3.2 European Spectrum Overview

This phase of the DSI covers the VHF bands from just below 30 MHz to 300 MHz and the lower UHF bands from 300 MHz to just below 1000 MHz. This portion of the radio spectrum is intensively used in most countries and is shared both geographically and in time. For instance, frequencies used for broadcasting may be reused several times in a medium sized typical CEPT country, to ensure that under normal propagation conditions interference will not occur between the various service areas. On the other hand mobile services in the major European conurbations often share a frequency in time, where a number of base stations in the same geographical area share the same radio channel.

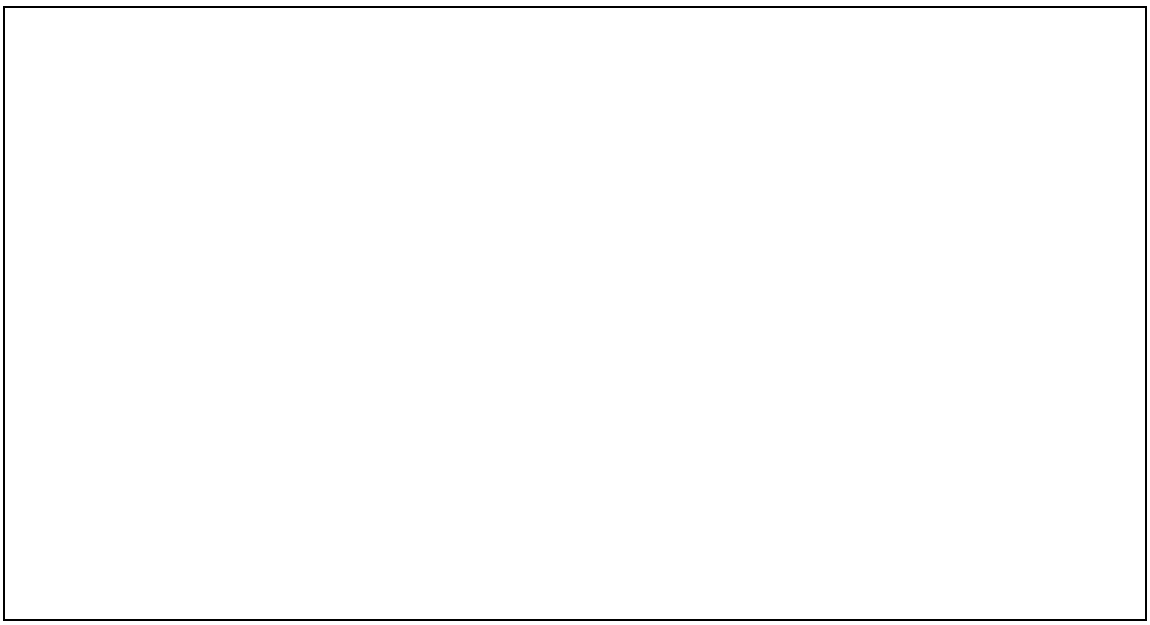

Figure 2.

Figure 2 indicates that on average in CEPT countries about 40% of the spectrum is currently allocated to broadcasting, 30% is allocated for defence and about 20% for all land mobile radio applications. It should be realised that these average figures are probably not representative of any particular country or group of countries since there are wide variations in the amount of spectrum provided for broadcasting, defence and mobile. Just as an example, concerning defence, 30% spectrum usage is probably about average for a large NATO country, however a former member of the Warsaw Pact military alliance will tend to use more spectrum for defence applications and a neutral country may tend to use less than 30%. On the other hand, an eastern European country will likely have less spectrum available for broadcasting than a western European country but within these broad geographical categories there are wide variations in the absolute amount of spectrum available for broadcasting. The remainder is divided between aeronautical and maritime use and miscellaneous other uses such as amateur radio, radio astronomy and space radiocommunications. It should also be noted that in a number of circumstances different radio services may be allocated the same frequency band, (for example VHF broadcasting in France shares with land mobile radio) which apart from making statistics difficult to prepare, reinforces the need for an understanding of compatibility questions and where the use of spectrum is different in an international context, the development of flexible co-ordination processes to ensure the maximum feasible use of the radio spectrum. It is also an important question when preparing a future European Table of Frequency Allocations, concerning whether or not it is desirable to move as a matter of principle towards a total harmonisation in the use of the spectrum in Europe, or leave some scope for sub-regional or national variations.

Spectrum congestion is an issue which the DSI addresses in a number of places, but during peace time this is only a real issue in some of the major urban areas of Europe or where some such areas are in the vicinity of international frontiers. However certain sectors continue to expand and this is reflected in the figures for average market growth in the land mobile radio sector which in the current recessionary climate continues to grow worldwide

at a rate of about 8% per year. The broadcasting industry is also expanding with a new generation of broadcasters and programme providers appearing on the scene, which may require spectrum resources for the production of programme material. The digitalisation of broadcasting will also have an impact on spectrum requirements especially for the next few decades.

These matters are addressed in detail in subsequent chapters and feature in the DSI's recommendations included in various chapters of this document.

3.3 Technical and Industrial Developments

Specific service or system related issues are discussed in the relevant chapters, however it may be of use to recall some of the technical issues which may have a bearing on the spectrum under investigation.

The radiocommunications sector is generally influenced by other trends in telecommunications, for example the increase in the number of operators and service providers, an overall trend towards the digitalisation of systems, a requirement for increased mobility and the convergence of the information technology, broadcasting and telecommunications industries (multimedia). This of course means that there are increased requirements for radio frequencies particularly in densely populated areas. Further, industry through innovative technology attempts to match the demand for new systems or to improve overall spectrum efficiency .

Turning then to specific examples, channel spacing for mobile radio analogue systems have during the last 50 years reduced from 100 kHz to 12.5 kHz with 5 kHz or 6.25 kHz systems currently being planned or introduced. It is however somewhat unfortunate that in the past, changes in channel spacings have not been introduced in Europe on a harmonised or homogeneous basis, negating some of the advantages which could have accrued from such spectrally efficient techniques. Modulation and access techniques are also on the move, digitisation having in some cases required increased channel widths for TDMA systems. In addition FDMA techniques are being developed for mobile applications, whilst spread-spectrum CDMA systems are already being deployed in the commercial environment outside Europe. The possibility of launching low earth orbiting spacecraft for civil mobile applications has been widely discussed and although principally envisaged to use spectrum above 1000 MHz, nevertheless systems are being designed and proposed in the VHF and low UHF bands.

A very large investment into research in digital broadcasting systems is currently being made. European Terrestrial Digital Audio Broadcasting (T-DAB) networks are likely to commence broadcasting in 1996, one year after CEPT's T-DAB Planning Meeting in July 1995. Digital Television is being actively pursued under the umbrella of the Digital Video Broadcasting (DVB) group and will present those responsible for regulating broadcasting and the radio spectrum with a number of political and technical problems.

European defence interests are also being reviewed as a consequence of NATO's and associated countries' new role in the post cold war era.

Undoubtedly a significant shift in the operational role of Europe's armed forces will require, subject to budgetary constraints, a technological response resulting in a decrease in defence spectrum requirements. It is also evident that the physical properties of radio waves could result in situations, where for certain applications, frequencies below 1000 MHz may provide the only operational solution.

In summary, technology has a continued role in ensuring that the spectrum is used in an efficient manner using cost effective systems and equipment. It is also recognised that technology has a significant influence on stimulating the development of new systems and services, although unfortunately not always with sufficient market analysis. It is therefore of continued importance that the links between the regulators in CEPT ERC and manufacturing industry and the standards bodies are strengthened and improved.

3.4 Market Developments

The market is playing an increasingly important role in radiocommunications activities at all levels and needs to be understood by those regulating telecommunications and radiocommunications; adopting an exclusively market approach to spectrum management has major implications when a theoretically finite resource is involved, such as the radio spectrum. However it has become evident in recent years that the market has not always been assessed correctly when spectrum has been designated for a new system and potential users have in some cases been confused by the proliferation of systems on offer, this is particularly relevant to the land mobile sector. As a result it is somewhat embarrassing for administrations to transfer existing users to alternative spectrum, only to find an unacceptably low take up of spectrum by the incoming system or service. The findings therefore of DSI Phase I concerning the need for market assessment within administrations is probably equally pertinent below 1 GHz as above 3 GHz.

However where there is a situation of demand exceeding supply it is necessary as a minimum to examine whether any form of pricing mechanism should be brought to bear in the radio licensing process. These issues are examined further in chapter 12.

It should also be recalled that the first phase of the DSI recommended that as a matter of course the direct and indirect costs of spectrum management should be reflected in the licence fees and charges to spectrum users. This was not foreseen as a revenue earning mechanism for governments, but was intended to be a significant step in establishing efficient radio regulatory agencies mandated to provide a quality service to their customers. Such considerations also seem to apply to the part of the spectrum currently under study and might be an element in a wider review of the spectrum management process. These matters are therefore also addressed further in chapter 12.

3.5 Global Standardisation

The process of standardisation is not limited to European activity alone, although in the commercial telecommunications environment, Europe tends to dominate in terms of detailed network and equipment standards. Even this generalisation can be misleading since the ITU Standardisation Sector (comprising the former standards work of the CCIR and CCITT) is engaged in telecommunications standards activities on a global scale. A notable example in the radio field would be ITU TG 8/1 preparing recommendations concerning the Future Public Land Mobile Telecommunication Systems (FPLMTS). Standardisation also occurs in other United Nations specialised agencies e.g. the International Civil Aviation Organization (ICAO) dealing with aeronautical radiocommunications safety issues and similarly the International Maritime Organization (IMO) which amongst other activities, regulates the Global Maritime Distress and Safety System (GMDSS).

3.6 Standardisation and the European Union's Regulatory Process

Following the creation of the single market, the European Commission (EC)• and the Council of the European Union (EU) have used, and are still using, the regulatory mechanism of Council Decisions and Directives to help ensure that European standards and regulations supersede their national counterparts. Following the recommendations contained in the EC's green paper of 30 June 1987, the European Telecommunication Standards Institute (ETSI) was created in 1988, subsequently almost all the technical standards activities of the CEPT were transferred to ETSI.

Within the standards for radiocommunications equipment those parameters concerning the efficient management of the radio spectrum are considered by CEPT administrations as policy matters falling within their sphere of competence. Such parameters are developed by the ERC's Spectrum Engineering Working Group in close co-operation with ETSI. For details of the co-operation agreement between CEPT ERC and ETSI see section 5.2. It is believed that a similar co-operation arrangement between CEPT and CENELEC concerning consumer radio communication standards would be beneficial and should be developed.

The 'Terminals Directive' 91/286/EEC makes it mandatory for national administrations to ensure that when terminals for some applications are placed on the market they must conform to a Common Technical Regulations (CTR) based on a Technical Basis for Regulation (TBR) developed by ETSI.

A number of additional Directives concerning European standards, safety, Electro Magnetic Compatibility (EMC), procurement and Open Network Provision (ONP) contribute to the regulatory framework. These Directives apply to all telecommunications equipment irrespective of whether they use wires or radio as the transmission medium. They are based on the principle of 'essential requirements' and are supposed not to hinder the freedom of

• Within this document the term European Union (EU) is used collectively instead of European Community (EC) or European Economic Community (EEC), except where the term EEC is used in the reference to a Directive. The term European Commission (EC) is used in preference to Commission of the European Communities (CEC).

manufacturers to customise their designs in the provision of 'non-essential' capabilities.

In the mobile radio area two systems designated to provide end to end voice services, GSM (Global System for Mobile communications in 900 MHz) and DECT (Digital European Cordless Telecommunications), together with ERMES (European Radio Messaging System, a pan-European land-based public radio paging system) have been covered by the 'Terminal Directive'. Professional Mobile Radio (PMR) and other radio systems are not covered. It is however expected that the mechanism of ERC Decisions, and the ERC/ETSI MOU will provide the necessary regulatory framework for most radio services in the future.

In 1986, the EU adopted a Directive which related to the adoption of a common technical specification of the MAC (Multiplex Analogue Components) packet family of standards for direct satellite television broadcasting in the 12 GHz DBS band (Directive 86/529/EEC). A further Directive followed in 1989 concerning 'Television without frontiers' which aimed to co-ordinate national measures on television broadcasting, providing for free transmission and reception of broadcasts from one Member State to another.

When spectrum usage is not harmonised in Europe, major difficulties will occur in the introduction of standards for new radio systems and terminals. Several Directives have been issued by the Council of the EU concerning the designation of frequency bands for mobile radio systems e.g. 87/372/EEC for GSM, 90/544/EEC for ERMES and 91/287/EEC for DECT. More recently the Council has recognised, through Resolution 92/C 318/01, the competence of the CEPT ERC for designating harmonised spectrum for Europe wide radio systems by the mechanism of CEPT ERC Decisions. Until now, the ERC has adopted Decisions on frequency bands for the co-ordinated introduction of Digital Short-Range Radio (DSRR), the Terrestrial Flight Telecommunication System (TFTS) and the Road Transport Telematic Systems (RTT). For the time being, only TFTS is being implemented, thus it will provide the first opportunity for evaluating the effectiveness of the CEPT ERC Decision process. It is hoped that the regulatory framework provided by ERC Decisions and the ERC/ETSI MOU will be effective as a tool for rapidly solving the difficulties of developing adequate markets for such products.

Already some issues are worthy of mention where improvements or additions to the framework might be considered, in particular:

- ERMES system development is hindered by difficulties of using the frequency band in several countries because of incompatibility with broadcasting cable TV and other radio systems.

- PMR development in some major European cities is still hindered by a lack of frequencies. This together with wide variations in channel arrangements throughout the entire band considered by DSI Phase II causes considerable difficulties. The most recent attempt to obtain harmonisation is ETSI's Trans European Trunked Radio (TETRA)

programme. Some possibility of obtaining a common frequency band for emergency applications in the short term appears likely, but for the main professional market there is little expectation for the imminent release of harmonised spectrum for such applications.

- limited harmonisation of spectrum in border areas, when it cannot be provided on a full European basis, will allow the creation of cross border regional services when market conditions are suitable, for example Alsace and Baden-Würtemberg or the Benelux area and Northern Germany.

3.7 Deregulation and Liberalisation

In recent years there has been a general move to liberalise and extend choice for the European telecommunications user. This policy is more advanced in some countries, but in the majority of CEPT countries some measure of deregulation has been achieved with private sector involvement in many of Europe's advanced public mobile systems. Private broadcasters cohabiting the broadcasting bands alongside traditional public service broadcasters is the norm in Europe, rather than the exception. Within CEPT decisions have been taken to exempt or grant general licenses for many low power applications.

Even so the mere act of deregulation requires additional regulatory provisions, to ensure that former monopoly operators or broadcasters do not abuse their dominant position in the market place. This can be a particularly difficult issue where a competitive part of the business can be subsidised from a sector where the operator enjoys monopoly privileges. However the regulator is always at a disadvantage since technological development often destroys the best laid regulatory plans. A case in point is where broadcasting, telecommunications, information technology and mobile communications join forces in a multimedia environment with enormous potential advantages for the user. Yet the investment involved is so enormous that the large telecommunications and broadcasting operators, often the former monopoly provider, are best placed to take advantage of such ONP developments to implement service. The regulator may have the unenviable task of holding back development in order that fledgling competitors are not overtaken by such developments.

Presumably only a small number of persons would complain at the extension of choice in European society, but where the radio frequency spectrum is involved there is a price to be paid. Extensive competition in the mobile service requires that sufficient spectrum be provided to an unspecified number of operators competing for the same or similar markets. The amount of spectrum necessary for such an exercise will therefore by definition have to be larger than the market can support, in order to permit churn between the operators. One can therefore conclude that excessive competition will tend to be wasteful of spectrum, not to mention the probable inconvenience and possible costs incurred by existing spectrum incumbents involved in a transfer process. On the other hand the provision of infrastructures for new systems

will hopefully stimulate the manufacturing sector which will bring associated advantages to Europe in terms of industrial activity.

Competition in terrestrial broadcasting and the associated intensive use of the broadcasting bands means that the introduction of new technology will be a rather problematical matter, probably requiring access to spectrum outside the conventional broadcasting bands.

On the subject of licensing deregulation, the penalty here is the absence of user information and the number of equipment involved. In terms of strategic planning of the spectrum it may prove rather difficult to consider a future change of use for a band which has been utilised for exempted equipment.

This section is not intended to be critical of deregulation, simply to suggest that within Europe it would be beneficial to develop a common understanding of an acceptable policy concerning the competitive use of the spectrum, in order to make optimum use of the resource in question.

3.8 European Table of Frequency Allocations and Utilisations

As indicated in section 1.4 a principal objective of the DSI process is to facilitate a European Table of Frequency Allocations and Utilisations to be implemented by the year 2008.

The DSI Management Team therefore recommend that the Table at Annex A to this document be incorporated as soon as possible into ERC Report 25 [•] with a view to the future transfer of this Report into an ERC Recommendation or Decision.

3.9 Comment

This chapter has attempted to look at various radio spectrum topics in order to set the scene for later chapters where many of the issues are addressed in greater detail. As a minimum it is hoped that the reader will have an appreciation of the complexities involved in spectrum management at the European level. It must also be remembered that CEPT administrations are integral parts of sovereign governmental structures and although most if not all administrations are favourably disposed towards European harmonisation matters, they must operate within varied and often complex national systems. As a minimum, sufficient time must be allocated to allow full discussions to take place with all interested parties, concerning any significant proposals for change. However on some occasions after extensive national deliberations, there are occasions when administrations feel they are unable to comply with majority decisions and cannot apply an adopted regulatory mechanism. It is

[•] CEPT ERC Report concerning the frequency band 960 to 3400 MHz and associated European Table of Frequency Allocations and Utilisations

believed that such situations must in future be reduced in number in order to arrive at a homogeneous environment which European industry can exploit to full advantage.

4. ERC Decisions

The past 2 years has seen a significant amount of activity within the ERC to ensure it is well placed to meet the challenges of the future. New rules of procedure have been adopted which at a Chairman's invitation offer the possibility for observers of organisations having an interest in European telecommunications to participate in appropriate meetings.

The ERC has also reviewed its strategy for the future by means of several studies addressing the internal business of the Committee. As a result policy objectives for the ERC have been developed which were approved in Autumn 1994. A number of recommendations from the policy group which developed the objectives, together with most of the recommendations of DSI Phase I are in the course of implementation.

Two additional studies have examined the ERO and the ERC, to review working arrangements and have developed various recommendations for the future, which will hopefully lead to improved efficiency throughout the ERC's constituent bodies.

This general review process will undoubtedly lead to important changes in the future but it has already achieved some immediate results. The adoption of the new 'ERC Decision' procedure is one example.

4.1 History

Prior to 1992, when 'CEPT ERC Decisions ' were introduced, the only CEPT radio regulatory output was contained in the CEPT Recommendations in the T/R series. In general, all radio services are covered by these Recommendations.

Each member administration of the CEPT is free to assess the extent to which these Recommendations are applied in their national regulations. This is one of the reasons why the process of adopting Recommendations has not been particularly effective. In almost every case Recommendations have not been implemented by all CEPT administrations and in many cases the Recommendations have only been partially implemented or implemented with national variations.

4.2 Need for Changes in the Decision Making Process of the CEPT

Following the transition of CEPT into an organisation of regulators, with standards issues being addressed by ETSI and fixed network operational matters falling to the European Telecommunications Networks Operators' Association (ETNO), attention has been focused on administrative and regulatory subjects.

A further reason for intensifying not only international co-ordination in Europe, but also the greater harmonisation of national legislation and regulation, is the

ever present goal of establishing an open market throughout Europe. The possibility to place telecommunications products in the international market place of other countries not only increases the opportunities for industry but is also beneficial to the user who roams to other countries.

These developments were recognised by the CEPT and at its plenary session in 1992, the 'Arrangement' which established the CEPT was reviewed. It was decided that in addition to the traditional CEPT Recommendations, the CEPT could also develop special arrangements aimed at reaching more binding commitments.

When considering such a process it must be remembered that the CEPT is not, like the ITU or the European Union, a 'treaty-based organisation'. The basis of the 'CEPT Arrangement' is that of an administrative agreement between administrations; the organisation therefore does not have the power to impose on members the requirement to implement its decisions in national regulations.

4.3 ERC Decisions

The need to improve the harmonisation of national regulations became more evident when the European Union (EU) agreed Directives with a view to harmonise the necessary national regulatory provisions to support the introduction of the pan-European telecommunication infrastructure. These Directives are binding concerning the result to be achieved whilst leaving to the national authorities the details of implementation.

Another aspect worth considering is that, in particular with respect to Directives based on Articles 100 / 100A of the Treaty of Rome, the EU has the exclusive competence to enter into agreements with third parties for such matters. In these cases, member states of the EU do not have the possibility of entering into agreements outside the EU without the consent of the EU-Council. Some third parties are outside the European Union but may be within the CEPT due to the larger membership of the latter organisation.

During October 1992 the ERC decided to review the various regulatory processes and agreed to introduce more binding agreements, known as ERC Decisions, where CEPT member countries are invited to commit themselves, on a voluntary basis, to implement the terms of these Decisions. The level of implementation is formally published and publicised thus giving a clear indication to industry and the public of the support given.

A formal mechanism for the adoption and implementation of ERC Decisions was developed by the ERC (see Annex F to this document). It should however be noted that this mechanism is currently being examined and refined and it is likely that a revision of the text in Annex F will be considered by the ERC during 1995. However the ERC has recently confirmed that ERC Decisions will be prepared on 'matters of significant harmonisation in the radiocommunications regulatory field'.

In addition to the relatively long standing ERC Decisions on DSRR, TFTS and RTT mentioned in section 3.6, Decisions on GSM, ERMES and DECT have recently been adopted by the ERC. These systems are also, to some extent, covered by certain Recommendations (as far as the introduction of these systems is concerned) or EU Directives addressing the designation of frequency bands required for these systems. As a consequence of the Directives, for formal legal reasons these three Decisions will not be available for implementation by EU and EEA countries.

A recent study of existing Recommendations has identified a number of additional candidates for ERC Decisions which should result in a wider implementation of their provisions within CEPT countries.

Concerning the implementation of CEPT T/R Recommendations and Decisions the ERO provides on a regular basis, information concerning the implementation of these texts. This document (ISBN 92-9135-005-2) is available from the ERO.

4.4 Compliance with ERC Decisions

A recurring theme from industry has been the fear that administrations who have committed themselves to implement an ERC Decision, will not take the final step of transferring the Decision into national law or implementing other administrative provisions which will ensure compliance with the terms of the Decision.

On the other hand the Management Team were equally concerned about situations arising where spectrum is requested for an application, political support is secured, existing spectrum users are inconvenienced and transferred, yet equipment is not manufactured or new users are not forthcoming and the spectrum in question lies dormant.

There therefore needs to be a change of attitude in Europe. Firstly from administrations to apply objective criteria to frequency management considerations in CEPT meetings, particularly where spectrum is to be refarmed for new applications. Currently important frequency allocation decisions are made after administrations have been invited to express their opinions in a meeting of the Frequency Management Working Group. Often only a few countries take the floor and a decision is taken on the preferred solution by a simple majority. Such decisions take no account of the overall economics of the various frequency options, for example the number of users affected or the investment in equipment in a specific frequency band. Thus a few countries with little or no use of a frequency allocation can outvote a country with a major network, which has perhaps been implemented only recently. Once appropriate criteria for determining frequency allocation questions have been developed and implemented, appropriate decisions can be taken in specific cases. The next step would then be for administrations to take the necessary administrative steps to free the spectrum in question and if necessary transfer existing users.

Ideally changes should be based on firm market information relating to the new application and should take place over a long time period in order to reduce the impact on existing users. However where short term (under 10 years) refarming is required the problem of the financial burden on existing users must be addressed by administrations.

In input material to the DSI, and in discussion, a number of funding options were mentioned, for example national spectrum funds managed by administrations and financed by various indirect taxation methods (special sales tax category for telecommunications equipment, an element in the station licence fee etc.) Some contributors were of the opinion that incoming users should finance the transfer of existing users, whilst others raised the point that industry should also be involved in the financing of transfers since if type approved equipment was to be manufactured and sold, companies' shareholders would directly benefit from equipment sales. Another option was presented which proposed that for EU member states the EC might finance or partially finance changes which favour the implementation of trans European networks.

It should also be borne in mind that even in the short term, refarming may not require the complete replacement of an existing users' system or equipment. Changing operational needs may make it possible to share or reduce the spectrum requirements of an existing user.

On the funding question the Management Team believe that the financial burden should be shared in freeing any spectrum identified for a new pan-European application. A funding mechanism should therefore be developed to facilitate refarming involving interested parties concerned with both incoming and outgoing radio systems. However it is believed that this mechanism can only apply to professional radio users. It would for example not appear practicable to compensate individual broadcasting users and amateur radio or model control enthusiasts for any change, incurring cost penalties, which may affect an existing frequency allocation. The funding process should extend to all CEPT countries where the new service shall be introduced.

Administrations might also offer incentives through reduced fees for professional spectrum users transferred as a consequence of any refarming exercise designed to improve spectral efficiency.

This matter will no doubt be debated in detail, but one possibility that has occurred to the Management Team is described as follows. Individual national CEPT administrations would announce their intention of introducing the new service and would invite all interested parties, including existing users, operators seeking licences, equipment manufacturers of both incoming and outgoing radio systems and members of the relevant national industry association(s) to a formal meeting. It would be a condition on the issue of a licence that the interested parties had negotiated the terms of a funding agreement which was satisfactory for the existing spectrum user, based on a standard costing formula to be agreed at the European level. It is believed that such an arrangement could sit within the legal framework of most CEPT

countries since administrations would not be directly involved in the raising of revenue.

Even with such procedures in place, it seems appropriate to establish the timetable for change at an early stage, one milestone in such a timetable would be a date when a consensus shall be reached on the refarming proposal. After this date, existing users would become subject to the transfer process. The process for developing the timetable through consensus will require particular attention, but might be determined through a series of open meetings held under the auspices of CEPT. Although not a legal document, all parties present when the timetable is approved would be invited to commit themselves through signature of a position statement.

The DSI Management Team therefore recommend:

- **the development of objective criteria to determine suitable frequency bands for new requirements. Such criteria should be based on the existing economic investment and occupancy of the candidate spectrum,**

- **that all new major requirements shall be the subject of market analysis before a decision is taken to allocate spectrum,**

- **that all involved parties shall be invited to commit themselves to the timetable by signature of an agreed position statement,**

- **the continuation of the ERC Decision process for major European projects involving spectral resources,**

- **that administrations initiate the administrative procedures necessary to free spectrum within the required time frame following their commitment to an ERC Decision,**

The following is a process the DSI Management Team would recommend for further consideration in the commitment process:

- **that the transfer of existing professional radio users from a frequency band which is required for a new application in the short term (within 10 years) be jointly funded by interested parties for example industry and operators (where appropriate) of the new system to a value based on a standard costing formula to be developed at the European level,**

- **that licensing would be conditional on successfully concluded negotiations,**

- **that CEPT administrations be encouraged to introduce incentive licensing regimes to encourage such transfers,**

- **that a timetable for each major spectrum refarming project be established on a European basis which shall be determined by consensus with all involved parties but in particular with administrations, equipment manufacturers and operators (where appropriate) of the new system,**

- **that the timetable mentioned above shall contain a date which shall be confirmed by all parties after which the transfer process of existing users shall be initiated.**

5. Co-operation in frequency management and standardisation

5.1 CEPT and the European Commission

The basic approach of the EC to spectrum related matters is set out in Council Resolution 90/C166/02 of 28 June 1990 on the strengthening of the Europe wide co-operation on radio frequencies. This Resolution calls for the promotion of the most efficient use of frequency spectrum and encourages the further development of the framework of co-operation between all parties concerned by the spectrum use. It also invites the Commission, the EU Member States and the CEPT to support the further developments of a new framework set up by the CEPT, including the setting up of the ERO.

This call for the strengthening of co-operation between the EC and CEPT stimulated several initiatives, including the signing in April 1994 of a Memorandum of Understanding (MoU) between the Commission and the ERC as well as a Framework Contract between the Commission and the ERO.

The MoU addresses the exchange of information between the ERC and the Commission and the co-ordination of activities and studies in the field of radiocommunications and also provides the basis of the Framework Contract. The Framework Contract provides for the specific allocation of tasks and funds to the ERO for particular studies by the ERO in the field of radiocommunications.

In September 1994, the EC confirmed a number of work requirements with the ERO to be carried out within the following year, including Mobile Satellite services, TETRA, DCS1800, Very Small Aperture Terminal/ Satellite News Gathering (VSAT/SNG), terrestrial Digital Audio Broadcasting (T-DAB) and a review of the consultation procedures used for the Detailed Spectrum Investigations.

These developments are considered to be an important step forward in the co-operation process between the ERC and the EC and will provide a sound basis for the implementation of a new approach to the co-ordination of radio frequencies in Europe.

ERC Decisions and the European Union

The commitment from at least all EC Member States to implement the terms of an ERC Decision will ensure the regulatory or legal basis required for an EU wide introduction of significant Europe wide radio services and systems.

In this regard, the Council of Ministers of the European Union adopted a Resolution* stating that Member States should actively participate in the development of ERC Decisions. Member States should in addition commit

* Council Resolution of 19 November 1992, on the implementation in the Community of the European Radiocommunications Committee Decisions (92/C 318/01)

themselves to implementing the terms of these Decisions (at that time only the Decisions on TFTS and RTT were available). The Council invited the EC to 'give full consideration to the mechanism of ERC Decisions as the primary method of ensuring the provision of the necessary frequencies for new Europe wide radio services'.

Following the adoption of Resolution 92/C 318/01 the EU has not enacted further regulatory measures on subjects which are now covered by ERC Decisions, however it may be expected that if the implementation of ERC Decisions is generally lacking in the European Union (or in the European Economic Area) additional regulatory measures will have to be taken. The relation between existing EU Directives (and Recommendations) and CEPT ERC Decisions covering the same subject is currently under study in the ERC. This in particular affects the CEPT Member countries which are not included in the EU (or EEA) and are not bound to the terms of EU Directives.

In support of the ERC mechanism of Decisions, and in particular relating to the implementation of these within the EU, a Proposal for a Council Decision 'on the implementation by the Member States of measures concerning radio frequencies' was prepared and adopted by the Commission in September 1993.

As explained previously CEPT Countries are free to commit themselves to implementing ERC Decisions. However, in the interest of providing the necessary frequencies for pan-European systems, there is a need to ensure that Member States commit themselves to implement the ERC Decisions but additionally there must be some guarantee that Decisions will be transposed into national law within a reasonable time frame. This will assist in an orderly introduction of these systems on a Europe wide basis.

Relating to the implementation of ERC Decisions which address the designation of frequency bands for pan-European systems in which the EU has an interest, the approach envisaged by the Commission is detailed in Communication COM(93)382: 'a New approach to the Co-ordination of Radio frequencies in the Community'.

Community instruments (e.g. Directives) will not be proposed on condition that:

- the ERC Decisions are in conformity with Community interests,

- all Member States implement the ERC Decision within a reasonable time scale,

- ERC Decisions are transposed into national law as follows:

    - all measures are implemented in conformity with the requirements set out for the appropriate transposition of Community Directives into national law,

- Member States transmit to the Commission within a reasonable period, the text of laws, regulations and administrative provisions necessary to comply with each ERC Decision,

- the Commission will publish in the Official Journal references to the implementing texts, in order to achieve transparency.

When particular EU Member States within the CEPT structure do not implement Decisions in accordance with these conditions, the EU may decide to adopt additional regulatory mechanisms (such as Directives) to ensure appropriate implementation within the EU and the EEA. Future work in the ERC on ERC Decisions will most likely address these issues.

Also worth mentioning here is that the proposed draft Council decision not only refers to the implementation within the EU (or the EEA) of ERC Decisions but is drafted in a general sense thus providing the possibility of including the implementation in national law of other important agreements reached within the CEPT, at a European level, but also on a worldwide basis, in the ITU.

It is believed that these procedures recognise the important and vital role international organisations play in the field of telecommunications.

5.2 CEPT and ETSI

As indicated in section 3.6 the European Telecommunications Standards Institute (ETSI) is responsible for the development of standards for telecommunication systems and equipment. The ETSI membership is composed of European regulatory authorities, network operators (including broadcasters), manufacturers, service providers, research institutes and users.

When developing standards for radiocommunication equipment there is a need to ensure that the radio spectrum is used efficiently, taking into account commercial and market requirements. Efficient use of the radio spectrum is also one of the so-called ‘essential requirements’ within which terminal radio equipment has to comply, in accordance with the provisions of Directive 91/263/EEC.

There is also a need for a mechanism to harmonise the introduction of ETS standards in the national type approval mechanism of CEPT countries. For radio terminal equipment falling within the terms of the 91/263/EEC Terminal Directive, implementation of (or parts of) these standards in the type approval mechanism is mandatory in the countries forming part of the EU or the EEA.

The ERC and ETSI have developed a Memorandum of Understanding (MoU) signed in 1993, which defines a co-ordination mechanism ensuring that a number of factors are considered in the process of producing ETSI standards.

Within the MoU it is stated that, 'the result of the co-operation procedure should be that ETSI will develop standards embracing all aspects of radio equipment and systems. The development of these standards for radio equipment and systems would take full account of the requirements for the efficient use of the frequency spectrum, economic and other factors and would result in ETSI standards which should be implemented by CEPT/ERC Members into regulations via a direct reference, without additions, modifications or deletions, except in justified cases to meet essential national requirements. It should result in regulations for type approval which are harmonised on a Europe wide basis for radio equipment both within and without the scope of the Directive 91/286/EEC'.

According to the MoU the general approach should be:

- for the ERC to provide sufficient frequency spectrum for new services, according to market demand and taking account of the requirements of existing services and of different categories of users;

- for ETSI to develop appropriate equipment and system standards which provide for, *inter alia*, the effective use of the radio frequency spectrum. ETSI, however, has also to consider economic, market related and system efficiency requirements and there should be, in principle, a proper balance between those and the spectrum management requirements.

There are two related co-operation procedures: one for equipment which falls within the scope of Directive 91/263/EEC, and a second for other radio equipment and systems.

In the first case, ETSI will develop Technical Bases for Regulations (TBRs) to be included in Common Technical Regulations (CTRs), based upon the essential requirements as given in Article 4 of this Directive. The ERC will designate the frequency bands to be specified in the standard. In addition, the ERC may advise the EC on the requirements for the effective use of the radio frequency spectrum, and related regulatory provisions in conformity with this Directive.

In the second case, ETSI will also develop standards reflecting these requirements, as co-ordinated and agreed with the ERC.

In both cases the ERC and ETSI have the shared obligation to identify and make known those requirements which affect the efficient use of the radio frequency spectrum.

In addition to this high level co-ordination mechanism, participation of an ETSI representative in the ERC and in the ERC Working Groups, especially the Spectrum Engineering Working Group, when dealing with relevant matters, as well as the direct participation of ETSI members in the work of the project teams of WG SE should ensure that mutually acceptable solutions are found regarding the essential requirements.

Co-ordination is also achieved by liaison representatives participating in the Working Groups of the ERC, and in ETSI.

The MoU has just been implemented and it is too early to review progress. However, it was noted that as part of the overall process the ERC should have a general knowledge of an ETSI standard before a final decision is taken on spectrum.

5.3 Co-operation between CEPT and the World at Large

The CEPT as the regional regulatory telecommunications organisation for Europe is normally orientated towards internal European problems and relations. However, during the preparations and in the course of ITU radio conferences the CEPT has traditionally consulted and co-ordinated with other regional organisations, or individual countries, in particular the major players in the World arena.

For almost 50 years the political situation has remained fairly stable and relations between countries and groups of countries have been firmly established and a certain balance attained. However during the last five to six years the political situation has changed dramatically producing significant changes to the CEPT organisation. CEPT now has a membership of 42 countries covering an area extending from the Atlantic in the west to the Pacific in the east. Because of these significant changes the balance established in the ITU over almost half a century has altered.

During this period the relationship between the United States and CEPT unfortunately deteriorated, noticeably at WARC MOB 87, the mobile radio conference held in 1987 but also at subsequent conferences. This was almost certainly caused by the ever present potential conflict between the desire to implement new systems and the need to protect existing users.

In order to improve relations and develop a better general exchange of information and co-ordination between the United States and CEPT, informal consultation meetings at the working level have taken place every 6 months since the World Administrative Radiocommunication Conference in 1992 (WARC-92). This exchange of information and the better understanding of each others terminology, problems and constraints has been of considerable benefit.

However it is believed that such contacts should not be limited to one country alone, but should occur on a regular basis between CEPT and other regional telecommunications organisations and key countries.

This matter was also considered important by the Management Team of the first phase of the DSI where in the Results Document it is stated that, ‘ it is also desirable that efforts should be taken to develop the CEPT’s relationship with the United States and other overseas agencies responsible for spectrum management policies in order to harmonise, wherever feasible, future spectrum allocations and utilisations at the global level’

The new arrangement for ITU radio conferences every two years, requires almost continuous preparations. Since the conferences have to be limited in length, a significant part of the ‘conference work’ will have to occur informally between the major international interest groups in the form of regular consultations.

In the various ITU fora, the major players have recognised the modern CEPT organisation with its increased membership and correspondingly larger potential voting power. CEPT should however use this influential position in future conferences wisely and in a positive manner.

6. Environmental Issues

6.1 EMC

The EMC Directive 89/336/EEC became effective in January 1995. The main purpose of this directive is given in Article 4:

'Apparatus shall be so constructed that:
- The disturbances it generates does not exceed a level allowing radio and telecommunication equipment and other apparatus to operate as intended,
- The apparatus has an adequate level of intrinsic immunity to enable it to operate as intended'

The Directive applies particularly to non radio equipment which should not cause harmful interference to radio equipment by transmitting spurious emissions. However, the application of the Directive to radio transmitting equipment is somewhat suspect since a transmitter by definition is normally required to produce wanted emissions at powers well in excess of a spurious signal.

For a long time, well before EMC problems had come to the fore, the arrangements for the mutual operation of radio equipment have developed from good frequency management practice and this is of course one of the main objectives behind the CEPT's and the ITU's approach to radio regulatory matters.

The DSI Management Team were informed that considerable confusion has been introduced to the frequency management process by the application of the EMC Directive to radio equipment. In particular the Directive states in Article 10.5 that any manufacturer having obtained an approval in a country for an 'apparatus designed for the transmission of radiocommunications as defined in the International Telecommunication Union Convention' is able to affix the CE mark. Equipment may then be placed freely on the market, even in those countries where the spectrum is allocated to another service. For the time being the debate continues on the differences between EMC and frequency management.

It appears that the main difficulty to be encountered in the near future will be the level of immunity of non radio or consumer apparatus submitted to high level electromagnetic fields arising from a general increase in the use of radio transmitting equipment in the domestic environment, for example from the numerous fixed, portable and mobile telecommunications equipment now found everywhere.

The DSI Management Team therefore recommend that CEPT administrations who are also Member States of the European Union press for a review of Article 10.5 of the EMC Directive to propose that the Directive applies to non radio aspects only. Further, the EC marking of radiocommunications equipment should only be possible when the equipment conforms to an appropriate European regulation, e.g. an EU Directive or a CEPT ERC Decision allowing for the free placing of such equipment on the market.

6.2 Health Hazards

Electromagnetic Radiation and the Environment
Electromagnetic Radiation and its environmental impact is described in terms of the possible effects of electromagnetic fields on flora, fauna and on human life. The main issue concerns the degree to which the human body actually absorbs electromagnetic energy.

Public Interest
In recent months the public has become increasingly critical of construction projects for cellular radio networks and the associated transmitter masts. Many discussions have taken place concerning the possible health hazards associated with the operation of radiocommunication transmitters. However, some of these discussions have not always been based on proven facts.

Standardisation
Since the invention of radiocommunications by Marconi, the possibility of harmful effects on human beings by electromagnetic emissions from radiocommunication systems has always been taken into account by defining relevant safety limits. In standardisation bodies, not only engineers but also biophysicists, medical experts and physicists have worked closely together and developed new and additional safety limits. In the last two or more decades these limits have been used in national, regional and global recommendations and standards in order to protect human beings within electromagnetic fields. When values have been included in national standards they became obligatory and have to be observed by companies establishing or operating radio systems.

It is regretted that as yet no harmonised European standards concerning electromagnetic radiation are available for suppliers of mobile telephones and other radio transmitters to consult. Equipment suppliers are nonetheless generally required by national law or regulation to advise users on minimum safe distances and exposure times.

Global Development
Possible hazards to the environment and to human beings from electromagnetic radiation are now discussed on a worldwide basis. Intensive research and calculations have been performed by various organisations, notably the International Non-Ionizing Radiation Protection Association (IARPA) which has led to positions, recommendations, standards and regulations. National standardisation organisations participate in the work of

the IARPA and results and recommendations from the IARPA are transferred into national positions or law and become obligatory.

Safety Limits
The actual safety limits from different countries as well as the limits from the IARPA relate to the actual operational situation and environment. The limits are presented in the Annex H (graphs and tables). The limits for the electrical and the magnetic field-strength as well as the power flux density are detailed. Within these limits the specific energy absorption of the human body including for weak and ill persons as well as for children has been taken into account.

It has to be noted, that the safety limits applied within the former Soviet Union are far less than the values recommended by IARPA, or other countries, although Soviet scientists participated in the work of IARPA and agreed to the recommended safety limits.

A distinction has to made between controlled and uncontrolled areas as well as between people who are exposed to radiation because of their profession and are aware of the risk and the general population (public). Uncontrolled areas are those areas which are open to the public and individuals who have no knowledge about the exposure. Complementary organisational and/or operational measures are required in order that the safety limits are not exceeded.

The distinction between controlled and uncontrolled areas is generally used in all countries. In addition the UK distinguishes between areas where children are, or are not exposed to magnetic fields.

Reflection
Whilst recognising that the development of recommendations concerning the biological effects of electromagnetic radiation are generally not the responsibility of radio regulatory administrations it is considered that every effort should be made to ensure that wherever possible installations are not licensed which endanger the public. In this regard the DSI Management Team were concerned to learn that despite considerable public interest and debate on the issue, European standards had not yet been developed in order to guide administrations, manufacturers, suppliers and users. However it is noted that studies are in progress within CENELEC under a mandate from the EC.

The DSI Management Team therefore recommend that CEPT administrations actively lobby concerned agencies within their countries to develop a European standard covering electromagnetic radiation which should include power density limits, safe distances and maximum exposure times.

6.3 Radio Sites

One important environmental issue that has not been addressed in DSI Phase II is the problem that operators and service providers experience in

respect of obtaining permission to establish radio sites. Environmentalists are rightly concerned about the proliferation of masts and towers, yet modern telecommunication systems using cellular technology require antennas to be placed in quite precise locations. Broadcasters too suffer from such problems. The owner of a well placed hilltop site has a valuable piece of real estate and this may increasingly become a factor in the establishment of competing telecommunication services. The DSI Management Team believes that this coupled with the environmental implications could merit further study.

7. Broadcasting Service

7.1 Introduction

A significant amount of spectrum in the frequency range from 29.7 to 960 MHz is currently allocated to the broadcasting service for FM sound and television broadcasting. The specific bands in use are 47-68 MHz (Band I television), approximately 65-74 MHz (FM sound broadcasting in eastern Europe), approximately 76-100 MHz (television in eastern Europe), 87.5-108 MHz (Band II FM sound broadcasting), 174-230 MHz (Band III television) and 470-862 MHz (Band IV/V television).

Since the European VHF/UHF Broadcasting Conference took place in Stockholm in 1961 the number of FM and television services have developed significantly in Europe. At present there are more than 30,000 FM and more than 40,000 television stations. Furthermore the audio links for programme production also make use of this part of the spectrum.

Today improvements in service quality and the number of programmes is limited due to spectrum and system limitations. The current developments in digital audio and television technology will offer a more efficient use of the spectrum together with new market opportunities. This will lead to a significant increase in the number of programmes in the future, without the need for more spectrum or alternatively to a moderate increase in programmes and a release of spectrum to other services.

However the introduction of digital services, which are incompatible with the current analogue services requires a certain amount of extra spectrum. The introduction of digital services requires careful co-ordination in order not to create interference to existing services. Planning conferences for the introduction of digital services are therefore desirable.

All contributions from broadcasting organisations, administrations, manufacturers of consumer products and the EBU indicate that there will be a change from analogue to digital broadcasting systems. Before analogue broadcasting transmissions can be switched off, a long transition period, during which both current analogue and digital services are transmitted is necessary. This period, according to the contributions, lies in the range 10 to 25 years and is necessary in order to change the hundreds of millions of receivers in Europe to new digital equipment.

7.2 Sound Broadcasting

7.2.1 Introduction

In most countries all or part of the band 87.5 to 108 MHz is used for FM broadcasting. However, in some countries in the eastern part of Europe the band from approximately 65-74 MHz is also used for FM broadcasting. The current frequency plan for the band 87.5-108 MHz is based on the Geneva Agreement of 1984.

In most cases FM transmissions contain stereophonic sound and often provides the Radio Data System (RDS). The RDS system is a tuning aid but also offers additional services for example programme information, traffic information, radiotext and paging.

The quality of recorded sound has improved considerably through the development of new recording techniques. The availability of digital sound storage systems and broadcasting to fixed receivers has made listeners aware of the extent to which sound quality can be improved.

The existing VHF/FM sound broadcasting system cannot fulfil such demands. This is particularly true under mobile reception conditions since the system was never designed or planned for mobile reception. The substantially increased demand for a diversity of programme services, to enhance listener choice, requires a more intensive utilisation of the frequency spectrum. Even if normal planning criteria (which are based on fixed reception) are enforced, this density of VHF/FM transmitters, together with the increasing use of high degrees of compression of the audio signal, lead to progressively more listener dissatisfaction, due to the increasing difficulty in obtaining satisfactory reception. This has led to the development of a new system, Digital Audio Broadcasting (DAB).

All contributions from interested parties which address this issue indicate the need for an adequate and harmonised frequency band for DAB, however the optimum frequency range for this band is the subject of diverging views. Most of the contributors wish to concentrate DAB in and around 223-230 MHz (TV channel 12). A few contributors see this as a temporary allocation and would like to promote the present FM band (87.5-108 MHz) as ‘the final home’ for DAB.

None of the contributors expects the introduction of so-called ‘in band’ digital systems in Europe. These systems are under development in the USA and are claimed to operate together with FM in the FM band. These systems are considered technically and commercially less attractive in the European situation.

For a supplementary extension of service capacity in Europe, another frequency range is under consideration. This is the 1.5 GHz band, of which the range 1452-1492 MHz was made available to satellite and terrestrial sound broadcasting at WARC-92. This frequency band will not be discussed here as it is outside the frequency range considered by the second phase of the DSI.

The following sub-sections will describe the current situation and developments in sound broadcasting, in particular the new DAB system .

7.2.2 FM - Frequency Modulation

All countries in Europe use frequencies in all or parts of the band 87.5-108 MHz for FM services and in most countries this band is used very intensively. Therefore, although there are still unserved needs, it is almost impossible to implement a significant number of new services due to the saturation of the band; this is not too surprising given that there are in excess of 30 000 stations in Europe.

FM stations have the potential to cause interference to Instrumental Landing System (ILS) and VHF Omnidirectional Range (VOR) services. Two broad classifications of interference known as type A and type B have been identified. Type A interference is associated with radiation at frequencies in the aeronautical radio navigation bands caused by intermodulation or other spurious emissions and out of band radiation. Type B interference is associated with radiation originating at frequencies within the broadcasting band. This type of interference is caused by non-linearities in the ILS/VOR receiver and by desensitisation.

In principle type A interference can be avoided to a great extent by careful planning of the FM broadcasting stations. Type B interference may affect many FM stations since any two FM stations over a wide geographical area may cause intermodulation effects within the first stages of aircrafts' receivers.

In practice it appeared to be possible to solve many of the predicted incompatibilities by applying multi-tier antennas or filters at the broadcasting station or by taking into account the operational aeronautical situation, or measured field strength of the ILS or VOR station. However some FM stations in the upper part of the band suffer restrictions in order to protect the ILS or VOR service. In 1998 the use of an improved ILS/VOR receiver will be obligatory, thus B type interference will start to decrease.

The 'General Assessment Method' described in Recommendation ITU-R IS.1009 and the co-ordination procedures used by the 'LEGBAC' group of countries offer an adequate method to calculate and solve incompatibility problems between FM and ILS/VOR. (See also Telecommunication Journal - vol.60-IX/1993)

In view of the development of DAB (see section 7.2.3) it may be expected that after 15 to 25 years many FM services will close. It cannot be assumed however that FM will cease to exist. Local broadcasters may continue to use FM for a considerable period of time.

An estimate done by the EBU indicates that after a transition period of some 25 years 10 MHz will still be needed for FM, however the EBU contribution suggested that the remaining part of the band 87.5 to 108 MHz could

become available for DAB or other services, depending on developments and the possibilities for allocating DAB in the upper VHF range.

7.2.3 Digital Audio Broadcasting

7.2.3.1 The DAB System

The final specification of the system is subject to an ETSI standardisation process which was scheduled to be completed during 1994.

The system fits within the criteria for a digital audio broadcasting system adopted in 1991 by the ITU-R through Recommendations 774 and 789 entitled 'Digital sound broadcasting to vehicular, portable and fixed receivers using terrestrial transmitters in the VHF/UHF bands' and 'Digital sound broadcasting to vehicular, portable and fixed receivers for BSS (sound) in the frequency range 500-3000 MHz' respectively.

The EBU/EUREKA 147 DAB system is, for the time being, the only system that complies with these requirements.

Other digital sound broadcasting systems have been presented on paper within the United States. However, these 'In Band On Channel' or 'Adjacent Channel' systems have not yet been demonstrated under mobile reception conditions.

The EBU has performed planning studies with these systems. The preliminary studies showed that the systems are very unlikely to be able to be implemented within Europe because the VHF/FM spectrum is much more intensively used in Europe than is the case in North America.

The DAB system is designed flexibly to include a range of source coding rates and channel protection profiles. Up to six stereophonic programmes plus some data capacity for programme associated, and non-associated data, can be accommodated in a COFDM block of 1.5 MHz.

In the very long term, FM can be expected at least partially to be superseded by DAB.

7.2.3.2 Spectrum needed for DAB

It is very likely that in Europe DAB will first be introduced as a terrestrial service from 1995 onwards. It is assumed that by the year 2008, DAB would be near the end of its implementation phase in some countries but only partially implemented in others. In all countries DAB will still be in a transition phase vis-à-vis FM; in this context, it is important to remember that there are 550 million FM receivers in use and their reliability is such that most of them will remain usable for many more years.

The EBU estimated the spectrum requirements in Europe to be about 25 MHz, considering the different types of coverages and the present sound broadcasting scenario of local, regional and national broadcasting. This

corresponds to a period where DAB will be fully developed and spectrum required for FM still required.

A possible scenario might be:

- 1997 20 MHz FM + 8.5 to 17 MHz DAB
- 2008 20 MHz FM + 25 MHz DAB*
- 2020 10 MHz FM + 25 MHz DAB

*) particularly for those countries which have developed DAB services most rapidly

All existing broadcasting bands below 1000 MHz are extensively used either by television (Band I, III and IV/V) or by FM (Band II) services. Because of the development of terrestrial digital television, there is a strong preference for avoiding the use of Bands IV and V for DAB. Experiments have shown that Band I may not be suitable for DAB because of high man-made noise levels. In Band III the frequency band 223-230 MHz (Channel 12) is less used for television, in some parts of Western Europe. For this reason the band 223-230 MHz is indicated by most countries as the most popular starting band for DAB.

7.2.3.3 Parking Bands

Some administrations favour the use of a parking band to commence DAB. In such a scenario DAB would start in or around 223-230 MHz and after a transition period of say 15 years services would be transferred to the band 87.5-108 MHz. This assumes that during this period, DAB would have obtained sufficient penetration to allow FM to close and be replaced totally by DAB. The concept of a parking band is also reflected in CEPT Recommendation T/R 52-02 which addresses the spectrum needs of T-DAB.

There are many arguments against parking bands:

- DAB is not likely to be a full replacement for FM
- the transfer requires careful planning and preferably every country should change in the same short period
- operators may delay starting DAB, in particular if they are not amongst the early starters
- it increases the network costs
- it does not allow a flexible development
- it complicates the receiver (much more than the inclusion of supplementary bands)

It could also be argued that the long-term future for terrestrial radio will be split between Bands II and III, however it should not be assumed that FM will cease to exist.

In any event, a harmonised frequency range of contiguous DAB blocks in Europe seems to be one of the major conditions required for a successful DAB service. Non-contiguous DAB block allocations would lead to sharing with many different services in the same and adjacent bands and in addition would introduce significant complexity in the planning of the new services.

7.2.4 Future Frequency Bands for Sound Broadcasting

The Management Team is of the opinion that of the presently available systems, DAB offers good prospects for efficient spectrum usage and can fulfil the needs for sound broadcasting provided that enough spectrum can be made available.

The concept of a 'parking band', that is to start DAB in the vicinity of 223 to 230 MHz and transfer at some point in the future to 87.5 to 108 MHz does not seem to contribute to spectrum efficiency as it may prolong the transition period and delay the development of DAB.

The DSI Management Team therefore recommend that the frequency range 216-240 MHz be allocated to Digital Audio Broadcasting in accordance with the following conditions:

216-230 MHz	**core band for terrestrial DAB. The band 216-223 MHz to be shared with analogue terrestrial television during the transition period to digital television in the UHF bands**
230-240 MHz	**sharing with military in time of crises**

It is additionally recommended that if necessary, 10 MHz in the band 87.5-108 MHz should remain for FM broadcasting to cater for a residual requirement for community and local radio services.

The introduction of DAB and the phasing out of FM broadcasting should be co-ordinated by means of planning conferences and a revision of the Geneva Agreement 1984. It should however be recognised that economical conditions are not uniform throughout Europe and the start and development rate of DAB may therefore vary from one country to another .

The DSI Management Team therefore recommend the following scenario for the introduction and development of DAB noting that a decision to hold a CEPT terrestrial DAB Planning Meeting in July 1995 has already been taken:

	1995	**CEPT planning meeting**
from	**1996**	**introduction of DAB**
	1999	**proposal to WRC-99 to additionally allocate the band 230-240 MHz to the broadcasting service and a**

footnote indicating that the band 216-240 MHz is intended for terrestrial DAB.

2005 **ITU planning conference for**

-planning DAB in the band 216-240 MHz and at 1500 MHz

-revision of Geneva Agreement 1984

-planning the withdrawal of FM services

-replanning the remaining FM services

from 2008 **phasing out of FM and extending DAB**

from 2020 **87.5- 97.5 MHz to be available for other services**

It is further recommended that this scenario and timetable be reviewed periodically in the light of any developments in the coming decades.

7.3 Television Broadcasting

7.3.1 Introduction

For television the following bands are used:
- Band I 47-68 MHz
- Band II 77-100 MHz (in some eastern European countries only)
- Band III 174-230 MHz
- Band IV 470-582 MHz
- Band V 582-862 MHz

The current Plan is based on the Stockholm Agreement of 1961.
Bands I, III, IV and V are shared with the mobile service principally for services ancillary to broadcasting (SAB). In several countries Bands I and III are used for Professional Mobile Radio (PMR) and other land mobile applications. Further, in a number of countries spectrum in Band V is used for other services. Some examples are 590-598 MHz for radio navigation, 608-614 MHz for radio astronomy and 790-862 MHz for the fixed and mobile (non SAB) services.

Television transmissions consist in most cases of a multiplex of a colour picture, one or two sound channels and data (teletext).

The existing analogue television systems have limited possibilities for improving the reception quality such as higher definition pictures, or portable reception. In many countries the number of television services has increased considerably in the last decade. This has been made possible by the use of improved planning methods and better receiver performance. However the analogue system and the available spectrum cannot fulfil the present programme needs in a number of countries.

Broadcasting services are also tending to merge with other media such as computing and telecommunications in so-called ‘Multimedia Services’. This trend additionally supports the need for transferring to digital television transmission systems. Administrations, broadcasters and industry have recently signed an MoU to establish a body known as ‘DVB’ to co-ordinate the development of digital television in Europe.

All contributions from broadcasting organisations, administrations, manufacturers of consumer products and the EBU indicate that the future of television is digital. To introduce digital television, all channels in all televisions bands are needed, including those which at present cannot be used for broadcasting. In the long term after the transition period less spectrum is expected to be necessary for terrestrial television broadcasting. In some contributions the broadcasting service is accused of not using spectrum in the most efficient manner .

The following sub-sections describe the current situation, developments in television broadcasting, the planning of television, multimedia, receiver performance and sharing.

7.3.2 Analogue Television

7.3.2.1 Current Situation

Television services are in use by virtually the whole population of Europe, roughly speaking ‘from the cradle to the grave’. This means that the number of users of the television broadcasting bands is some 800 million people. This represents both a large number of people and also a large investment in receiving equipment (receivers and antennas); there is also a considerable number of portable receivers, a factor which must not be overlooked.

The number of persons per television set is not constant throughout Europe. A conservative estimate of the number of sets in Europe is 300 million with a value of approximately 250 thousand million ECU. To this must be added the value of television studio, outside broadcast, link and transmitter and antenna installations and the employment, direct and indirect, of several hundred thousand people. The number of transmitters in operation is in excess of 40,000 although it should be noted that half of these are of low power (less than 10 W erp) and reflect the public service commitment of providing services to small, isolated communities, sometimes consisting of only a few tens of people. The channels used by these stations are, of course, also reused by high power stations serving much larger communities.

7.3.2.2 Developments in Analogue Television

Some countries still have the possibility of introducing new television stations or even networks utilising current analogue technology. It is however obvious that every channel taken into operation for analogue television will reduce the possibilities for the future introduction of digital television.

There is a tendency in some eastern European countries to change from SECAM to PAL. If that change were accompanied by a change in the RF-standard, incompatibilities may occur. In order to solve these problems additional spectrum may be needed.

Some countries, will introduce an improved version of the current PAL system, the so-called 'PAL-Plus' standard. This system offers wide screen reception and improved picture quality. The system is compatible with PAL, but to benefit from the improvements a new (wide screen) receiver is necessary. In principle the introduction of PAL-Plus does not require extra spectrum. PAL-Plus programming is expected to start at the end of 1994.

Some believe that by introducing PAL-Plus now will facilitate the introduction of digital television. By the time digital television starts there will therefore be wide screen (PAL-Plus) receivers in the homes, such receivers only require a set-top box in order to receive digital (wide screen) television. Others however think that the introduction of PAL-Plus will extend the life time of analogue television and thus prolong the transition period.

7.3.3 Digital Television

7.3.3.1 Digital Systems

There is currently a very large investment in research regarding digital television systems. This research is expected to culminate in the development of systems which can encode a television signal into a bit stream of 4 to 30 Mbit/s (depending upon the quality target) and then transmit this within an 8 MHz channel. Indeed, there are developments which will put more than one television programme into an 8 MHz channel, although the robustness of the resulting signal is of course reduced. In addition, the digital signals will be relatively immune from impairment resulting from interference and thus an improvement in spectrum utilisation efficiency is to be expected. This could be quite large where single frequency networks can be employed, but would be much less when digital systems replace the analogue ones which are already using spectrum saving techniques such as precision offset working.

7.3.3.2 Planning Aspects of Digital Television

System Aspects

The digital television systems which are at present under development offer great flexibility in service and network design. These systems offer (in principle) the possibility of High Definition Television (HDTV), Enhanced Definition Television (EDTV), Standard Definition Television (SDTV) or Low Definition Television (LDTV). Instead of HDTV or EDTV a number of SDTV or LDTV programmes can be transmitted in the same (8 MHz) channel. Also emissions having different quality parameters can be transmitted in a hierarchical manner, providing the possibility of receiving HDTV under favourable conditions or with an appropriate receiver, receiving a lower quality version of the same picture under less favourable conditions. It is also

possible to adapt the channel coding to the required reception condition, for instance a very rugged modulation system for portable reception and a less rugged modulation process for fixed reception.

The different options will require different bit rates and different signal to noise ratios, there are several systems under development, but in general the following are considered applicable:

service	bit rate	service	bit rate
1 SDTV	6 Mbit/s	4 SDTV	4x6 Mbit/s
1 EDTV	12 Mbit/s	2 EDTV	2x12 Mbit/s
1 HDTV	24 Mbit/s		

The signal-to-noise ratio will range from 8 dB for a single SDTV programme per channel, to 26 dB for HDTV or multi-programmes per channel. For comparison, analogue television requires protection ratios ranging from 22 to 45 dB depending on the offset condition and the use of precision offset.

As the spectral characteristics of digital systems are noise like, the required signal to interference ratio is similar to the signal to noise ratio in so far as the interference of digital to digital transmissions is concerned.

In the case of interference to and from analogue television services the following figures are utilised in planning studies performed by the EBU:

Interference to analogue television (PAL):

36 dB for tropospheric interference conditions
43 dB for continuous interference conditions
(These values are the means of values reported by the system proponents)

Interference from analogue television:

10 dB below the digital system's required C/N ratio. This value is representative of several of the systems under study.

Network Aspects

Similarly to DAB, digital television systems offer the possibility of operating in a Single Frequency Network (SFN) environment. If local programming during all of part of the day is necessary, Multi Frequency Networks (MFN) may be considered.

Depending on the service requirement in general the following network concepts or combinations may occur:

large SFN — all stations having (exactly) the same programme operating on the same frequency. Existing sites are envisaged.

MFN	all stations operate at different frequencies, as in a conventional television network and may transmit different programmes
mini SFN	a station is supplemented by smaller stations all operating on the same frequency and transmitting the same programme. The power is less than where the main station had to cover the area alone. The network can be tailored to the service area. This concept is sometimes also called ‘Distributed emission’.
dense SFN	like large SFNs, but with small distances between the transmitters.

The SFN concept is very spectrum efficient, not only because of the use of the same frequency, but also because of the so-called network gain. This means that the signal powers of two or more transmitters are statistically added. For two transmitters the network gain may be up to 8 dB.

All these different services (multi-programme, HDTV, SDTV etc.), receiving conditions (fixed reception, portable reception), and SFNs, MFNs and combinations thereof provide a great variety of possibilities.

Analogue television has been planned for fixed reception with directional outdoor antennas. Portable reception is possible only to a limited extent due to multipath interference and the relatively high wanted signal to noise ratio.
With digital television portable reception is a real possibility; the system is immune to multipath interference, delayed signals even improve the reception and the required signal to noise ratio can be low.

It may be expected that an increased use of portable receivers (including static receivers with a simple rod or ‘rabbit ear’ antenna) will reduce the possibility of being able to apply polarisation discrimination. It may also be expected that techniques such as mini SFNs will improve portable reception in parts of the service area.

7.3.3.3 Spectrum Requirements for Digital Television

Introduction

When considering the amount of spectrum needed for terrestrial digital television services in Europe, it is necessary to deal with two entirely distinct time frames. The first is the transition period when digital services will be introduced into the bands used by the existing analogue television services. The second is the final situation when the analogue services have been closed down and only digital services remain.

Because there are several hundred million television receivers in use in Europe and because the minimum lifetime of a modern television receiver is at least seven years (after which it may be regarded as a second or even third

receiver), it is essential that the transition period is sufficiently long to avoid any disruption of service. Of course, it would always be possible to envisage a shorter transition period provided that ‘someone’ (other than the viewer) pays for the replacement of all television receivers. As this seems unlikely, it is perhaps not unreasonable to assume that the transition period will last 15 to 22 years from the introduction date of digital services (see also section 11.8). As the latter date will not be the same in all European countries and as it is unlikely to occur in any country before 1997, it is easy to see that the transition period will last for such a long period that any prediction about the post-transition era must be considered somewhat speculative.

During the Transition Period

European countries can be split into two categories, those which have 8 MHz VHF channels, essentially those in eastern Europe, and those which have 7 MHz VHF channels, essentially those in western Europe. This second split is important because the digital television system currently being developed in Europe is being designed for an 8 MHz channel. During the transition period, digital television services in western Europe will be mainly confined to the UHF channels.

The discussion on spectrum requirements will concentrate in this section on the capacity of the UHF bands. However some countries may be able to introduce digital television in the VHF bands. In any case, the UHF channels represent a high proportion of the spectrum available for terrestrial television broadcasting. In the longer term, one could envisage the VHF band (or bands) being re-planned with 8 MHz wide channels throughout Europe, but as noted earlier, it is perhaps premature to speculate about requirements for the year 2020, or even 2015.

A further split may be made into those countries which have access to channels above 790 MHz and those that do not. While this split may be simplistic, it is convenient in the context of the introduction of digital television services.

The reason that access to spectrum above 790 MHz is important is that for those countries which have no current access, these channels might represent a good opportunity to introduce single frequency networks (SFN) which could maximise the capacity of the available spectrum. At present, it seems unlikely that this could happen in many countries because of the commitments to analogue broadcasting and other services currently using spectrum above 790 MHz. For those countries which already have access to this part of the spectrum or which have neighbours with such access, then conventional (that is non-SFN) planning will be required and this requires that channels will be shared by the existing analogue and new digital services. While some frequency re-planning may be undertaken to effect an optimal re-distribution of channels, this can only be very limited in extent in order to avoid any significant disturbance of existing reception conditions - primarily because most viewers already have fixed receiving antenna installations.

During the transition period, the majority of digital television services are likely to use any spare capacity which can be found from within the UHF channels. In those countries with fully developed networks, the capacity which may be available is very limited and extensive planning studies have shown that this will have the effect of restricting the coverage which is attainable by digital services.

Such coverage limitations increase the problems of terminating the transition period. In effect, one only reaches the end when all viewers have receivers suitable for digital transmissions. If there is a significant proportion of viewers who cannot receive the digital transmissions, how can the analogue services be discontinued - unless such viewers are already equipped with a digital reception capability? For those viewers with no access to digital transmissions, what is the incentive to buy a new digital receiver, or even a dual-standard receiver which will inevitably be more expensive than one with an analogue-only capability? With market liberalisation, one can no longer rely on legislation or regulation to impose the sale of digital only receivers. One possible solution would be to make more spectrum available for television broadcasting, and use this for all (or at least many) of the digital services. This could, of course, only be done at the expense of other users.

The conclusions from these discussions necessitates that during the 15 to 22 year transition period there will be an increasing use of the UHF channels currently available for terrestrial television and that to effect an orderly transition to an all-digital long term future, considerable benefit could be obtained from the wide spread availability and use of additional UHF channels.

During the whole of the transition period, television Bands III, IV and V will continue to be the primary medium for many broadcasting services and will also form a key part in the strategy for the transition from analogue to digital systems. In some countries for operational reasons there may also be a need to continue using Band I.

After the Transition Period

It is envisaged that many new market opportunities will arise during the transition period and the added flexibility which digital television can offer will further increase market possibilities. For example, the various facilities that interactive television may provide are only just about to be explored. Services such as tele-shopping demonstrate that there are many old markets which might be more fully exploited in addition to new ones. These opportunities are of course all market driven rather than service driven.

It is difficult at this stage to predict the spectrum requirements for digital television in the long term. However, some estimates can be made.

Long term scenarios can be categorised by services aimed at maximising the size of the coverage area to the number of programmes provided in limited areas. Combinations of both scenarios are of course possible.

The first possible scenario is based on large SFNs and has the objective of maximising the size of coverage areas. However neighbouring areas also require channels, it is thus necessary to share the available channels between service areas. About 8 channels will be available in the existing UHF broadcasting bands for such wide area coverage. This could provide for example 16 enhanced definition (EDTV) programmes, portable reception would also be possible in limited areas. In addition the channels used in other large service areas could be reused with appropriate geographical separation for local services.

The second scenario applies when local or regional coverage together with portable reception are the main objectives. In most cases all channels can be used in limited non contiguous areas.

In these areas mini or dense SFNs can be used to optimise the coverage. If all channels in the existing UHF broadcasting bands are available in a certain local area, 40 programmes using a very rugged modulation method could be received with portable receivers. Outside the area and depending on the reuse distance employed, fixed reception would also be possible.

7.3.4 Receiver Performance

Since 1961 when the Stockholm Plan was adopted, receiver performance has improved considerably. In 1961 it was necessary to avoid image channels and those channels near the local oscillator frequency, nowadays such precautions are not considered necessary.

Further, the selectivity of receivers has improved, which makes it possible to use adjacent channels in the same area. A number of countries have made use of these developments by introducing extra stations for local or commercial broadcasting without causing any additional interference within the service areas of existing stations.

It should however be noted that television receivers are consumer products and are consequently extremely sensitive to price. Therefore industry often introduces compromises into receivers' designs to keep costs to a minimum.

The EMC aspects of receivers are dealt with in CENELEC TC 106. The current European standard is EN 55020. The requirements of the EMC Directive (89/336/EEC) which will embrace EN 55020 is mandatory for all receivers sold after 1 January 1996.

7.3.5 Interrelation between Terrestrial, Satellite and Cable Distribution

The technologies involved with computing, communications and broadcasting are converging and new network-services are thus likely to be developed and introduced.

The trend to carry more services in a telecommunication network will increase. New developments in broadcasting technology, in addition to traditional sound and television services, will also be used as a means of transport for other (data) services. These additional services will not only serve the consumer but also the business markets.

This may have an influence on other radio services as well. A well known example is paging via broadcasting networks. Other applications, which are at present mainly carried on telephone lines may also use broadcasting networks in the future. Broadcasting networks are an economical and attractive alternative particularly when large amounts of information have to be sent at the same time to many fixed, portable or mobile receiving points. Some examples are electronic newspapers and financial and business data.

New applications will also emerge for the consumer market in addition to traditional broadcasting applications. Interactive television will offer new services such as video on demand, educational programmes, news, childrens' video, banking services, tele-shopping and games, additional entertainment channels will also be offered.

Broadcasting will not be an independent service, but part of the 'electronic super highway'. Besides cable and satellite broadcasting, terrestrial broadcasting will have its place in the multimedia services of the future in particular as a mobile and portable outlet of the 'electronic super highway'. In the future a broadcaster, or more generally a programme provider, will have to choose between such transmission mechanisms as terrestrial broadcasting, direct to home satellite, medium power satellite, MVDS, cable television networks or even copper wires. Any combination of these may be used to bring the programmes to the consumer.

The operators choice will be influenced by transmission costs, programme rights, quality criteria and coverage aspects.

The digital television system which is under development in Europe in the Digital Video Broadcasting (DVB) Project has a satellite, cable and terrestrial variant. Many parts of the system are common, only the modulation and channel coding are different in order to be adapted to the relevant transmission mechanism.

Terrestrial Broadcasting

It is generally expected that terrestrial broadcasting will be the main transport mechanism for local and regional services and for portable and mobile reception.

However terrestrial broadcasting may also play a role in the future for national networks. It has been reported that considering security issues only, national

programmes may be transmitted by terrestrial networks, as these networks are under the direct control of the broadcasting organisation or its contractor. Even if control of a part of the network is lost, this does not necessarily mean the total loss of control of all programmes throughout the country.

Commercial control of some multinational media consortia providing satellite transmissions and the debate concerning conditional access systems may also have an impact on the use of terrestrial networks for national programming.

Interactive television is under study in many fora. One possibility is to use the receiving antenna as the transmitting antenna for the return path. This could be an attractive solution in sparsely populated areas with an underdeveloped telephone infrastructure.

Satellite Broadcasting

In the near future, broadcasting satellites will offer the possibility of transmitting a multitude of programmes. Some of these programmes will also be transmitted by cable systems. It is expected that many of the programmes will be encoded.

Satellite broadcasting does not have the same spectral constraints as terrestrial broadcasting and in principle may be more suitable for systems requiring a large bandwidth, e.g. HDTV.

However the use of satellites has implications on the power available, the use of high gain receiving antennas is necessary.

Cable Distribution

In many countries the use of cable systems is increasing, especially in densely populated areas where subscriptions can be offered at a competitive price. It is not expected that cable systems will achieve full coverage. However, in some small, densely populated countries it is expected that 95% of households will be served by cable systems. Many cable operators want to expand their transmission capacity by introducing digital compression techniques. These techniques may not necessarily be compatible with those used in digital broadcasting. The DVB project however has developed a cable variant for digital television.

Well constructed cable networks are not sensitive to interference from off air transmissions, however poor shielding of cable systems results in inadequate immunity and causes interference to other radio services. Home installations are generally the ‘weak link’ in cable networks and are often sensitive to interference from ‘local’ off air transmissions. Therefore channels used locally for terrestrial television are invariably not used on the cable systems.

The increasing use of (digital) terrestrial television or DAB channels and the increasing number of cable transmissions may increase the possibility of interference in cable systems with insufficient immunity.

7.3.6 Programme Categorisation

National Programmes

Full national coverage and even supranational coverage can fairly easily be realised via satellite for a national service, provided that there are no, or few, regional variants. As many households in Europe already have a receiving installation for satellite broadcasting services, it may be possible to consider the transfer of all national broadcasting services to satellite, irrespective of the introduction of new digital services. However, the concerns expressed above must not be forgotten.

The distribution of programmes by public service broadcasters cannot, within the foreseeable future, be based on cable systems only, as the 'coverage' and penetration achieved by these networks is not considered to be adequate.

Regional and Local Programmes

The tendency, in recent years, is for broadcasters to provide regional programmes in addition to national ones. It is believed that such programming is welcomed by both the general public and regulators.

Over the last few years, local or community radio and television programming have also become popular. In some European countries several hundred local radio stations are already in operation. While local television services are less common, there are a number in operation.

Regional and local programmes are not normally broadcast via satellite mainly because of the costs involved (especially with English language programming because of copyright considerations) but also because it would be an inefficient use of spectrum to do so.

Interactive Television

Interactive television systems, where the viewer chooses from a central programme library the programme that he individually wishes to watch, are beginning to appear on the scene. Services of this type will mainly operate on cable systems as their individual nature would demand too much spectrum if transmitted over air. Other forms of interactive television offer the possibility to respond directly to a programme. This can be realised via telephone lines or radio telephones and does not necessarily require additional spectrum.

7.3.7 Portable Reception

Although frequency planning for VHF/FM and television up to now has only been performed for domestic (stationary) reception using outdoor antennas, it is a fact that many receivers in use are not connected to such an antenna (either individually or via cable networks). Well known examples are:

- car receivers (FM);
- clock radios (FM);
- hand held or pocket receivers (FM);
- portable TV-receivers.

These types of receivers use simple antennas either built into the receiver or directly attached to it.

While virtually all radio reception is by means of portable receivers, the use of portable television receivers in Europe has not yet achieved the degree of penetration that has occurred in North America. One major reason is the higher field strengths within the primary coverage areas used in the US; this is the direct result of the higher radiated powers which are used.

With the expected introduction of digital broadcasting services which are more robust than the current analogue services, a wider use of portable receivers is to be expected in Europe.

Many services have or are tending towards an increasing use of portable receiving equipment. Examples are:

- pocket-size mobile telephones;
- cordless telephones;
- wireless PABX systems;
- radio-LANs (local area computer networks).

It seems highly probable that television reception will also exhibit the same trend. The limitations which exist today are caused by poor picture quality on portable receivers, partly as a result of noise (caused by inadequate signal level) and partly by the severe degradation caused by delayed image signals (‘ghosts’). The use of a digital transmission system will offer major improvements in picture quality primarily because the energy in reflected signals can be used constructively rather than causing destructive ghost images as occurs with an analogue system. However portable reception can only be provided practically by means of terrestrial transmissions. Satellite based transmissions require high gain, very directional receiving antennas which demand accurate positioning and in many cases have to be situated outdoors with a clear view towards the relevant satellite. While some of the problems of portable satellite reception could be eased by the use of non-geostationary satellites (in place of the geostationary systems normally considered) these do not seem to be economically viable.

This does not imply that transmitter planning should be based on the need to provide coverage to portable receivers, rather it is the case that planning for roof level antenna reception would also permit portable reception in some areas, especially those close to the transmitters. With a robust system, the percentage of viewers able to obtain reception on a portable receiver could be sufficiently high to attract a large audience and correspondingly large sales of portable receivers.

7.3.8 Sharing

Sharing with television broadcasting spectrum is in principle possible and also occurs in practice (see also section 7.3.1). Suitable criteria for sharing (analogue) television with mobile and fixed services can be found in Recommendation ITU-R IS.851. Sharing criteria between digital television and other services have not yet been developed.

Although in principle possible, sharing with television is limited in many cases because of the intensive use of the spectrum and the relatively high powers used by television stations. Sharing possibilities will further decrease during the transition period from analogue to digital television, as more (digital) television stations will be introduced.
In future, digital terrestrial television may be used mainly for urban coverage. In rural areas sharing possibilities may increase. However, the demand for sharing with civil land mobile radio arises mainly in urban areas therefore sharing a broadcasting band with such services in the conurbations may not result in the maximum use of the available spectrum.

7.3.9 Future Bands for Television Broadcasting

The Management Team is of the opinion that digital television will change the terrestrial broadcasting scene considerably. The introduction of new digital transmission systems with a higher spectrum efficiency than current analogue systems may lead to a lower demand for spectrum in the far future. The development of satellite and cable services could lead to a further decrease in this demand. On the other hand it may be expected that there will be an increased demand for programmes and services together with a need to consider portable reception. At this stage one can therefore only speculate about the totality of long term spectrum needs for terrestrial television broadcasting.

It is therefore recommended to utilise during the transition period from analogue to digital television broadcasting, the entire frequency range 470-862 MHz for digital television provided that any channels that may become available in the short and medium term are <u>not</u> used for extending the analogue broadcasting network(s). Where possible television transmissions in the frequency range 47-68 MHz should cease.

After the transition period, less spectrum may be needed for terrestrial television.

It is therefore recommended to immediately allocate where feasible the frequency band 47-68 MHz to other services and to review the other broadcasting bands used for television during the transition period. The band 174-216 MHz is a prime candidate for consideration. Subject to future decisions on broadcasting and land mobile policies, the band 470-510 MHz may also be a candidate for reallocation.

The introduction of digital television and the phasing out of analogue television should be co-ordinated by means of planning meetings and conferences, the Stockholm Agreement 1961 should also be abrogated or revised. In order to facilitate a successful outcome of the planning exercise every effort must be made to ensure that the necessary planning parameters are available 12 months in advance of the date of the planning meeting.

It should also be recognised that the economic situation varies considerably between European countries consequentially the start and development rate of digital television may therefore vary from country to country.

The DSI Management Team therefore recommend the following scenario for the introduction and development of digital television:

early 1997 planning parameters approved

early 1998 CEPT planning meeting for the introduction of digital television

end 1998 introduction of digital terrestrial television

2005 ITU planning conference for the:

-determination of the future requirements for terrestrial digital television

-revision of the Stockholm Agreement 1961

-planning the withdrawal of analogue services

from 2008 phasing out of analogue television

from 2020 subject to review, possible use of the band 174-216 MHz and perhaps also 470-510 MHz for other services.

It is further recommended that this scenario and timetable be reviewed periodically in the light of developments in the coming decades.

7.4 Services Ancillary to Broadcasting

7.4.1 Introduction

Services Ancillary to Broadcasting (SAB) support the activities carried out in the making of programmes. Such activities might be at an outside broadcast (OB) event (including news locations), or within a studio.

This section does not deal with radio microphones for non broadcasting purposes. The spectrum needs for these applications are dealt with in section 10.10.3.

Within the DSI Phase II frequency range 29.7 MHz to 960 MHz, there are broadly four different types of SAB application:

- Radio Microphones
- Programme Circuits
- Special programme feeds for OB-production staff to allow their contributions to fit smoothly and on time into a broadcast.
- Remote-control information transmitted to technical equipment such as automatic cameras.
- Production Talkback
- Production Communications and Data

Radio Microphones are low power (< 1 watt) devices to convey very high quality audio, including voice, music or other sounds, from individual performers to a control point.

Programme Circuits employ higher powers (normally up to 25 watts but sometimes more) to carry programmes or programme inserts from an outside broadcast event to a studio centre.

Production Talkback circuits carry instructions from the director and others controlling the production. The information is relayed in real time to all those involved in the production of the programme.

Production Communications and Data

Special programme feeds allow OB production staff to fit their contributions into the broadcast smoothly and on time.

Remote control information transmitted to technical equipment such as automatic cameras.

The categories are summarised in the table below:

Table 1: SAB Applications

Service	Category	Transmission mode
Radio Microphone	wide band/low power	continuous, single frequency
Programme Circuits	wide band/high power	continuous, single frequency
Production Talkback	narrow band/high power narrow band/low power	continuous, full duplex, or press-to-talk on return path
Production Communications	narrow band/high or low power	single frequency, press-to-talk
Data	narrow band/low power	continuous

Almost all contributions from broadcasting organisations and the EBU stress that there is an increasing need for these services, however sharing possibilities in the broadcasting bands are decreasing and this trend is expected to continue.

In some countries SAB co-ordination bodies have been created.

The following sub-sections will describe the current situation in the frequency range 29.7 to 960 MHz, developments concerning frequency harmonisation and the sharing of spectrum with services ancillary to broadcasting will be addressed.

7.4.2 Spectrum Usage

7.4.2.1 Current Usage

Currently almost all of the bands within this phase of the DSI are used for SAB operations in one or more CEPT countries. This is possible because of the low radiated power requirements (e.g. radio microphones) or the transient nature of outside broadcast locations. Consequently SAB applications commonly share spectrum that is used by other services.

A survey of EBU members has been carried out to obtain information on the use of spectrum for SAB. In order to simplify the presentation of the results of the survey, production talkback and production communication links are combined into one category. However, it is important to note that most operations falling into the latter category require instant access and/or continuous use of a channel.

The utilisation, by country, of each band is shown in figure 4. All bands, with the exception of 108 to 136 MHz (an aeronautical band), are used somewhere for SAB operations. Figure 3 provides a band by band analysis of available data.

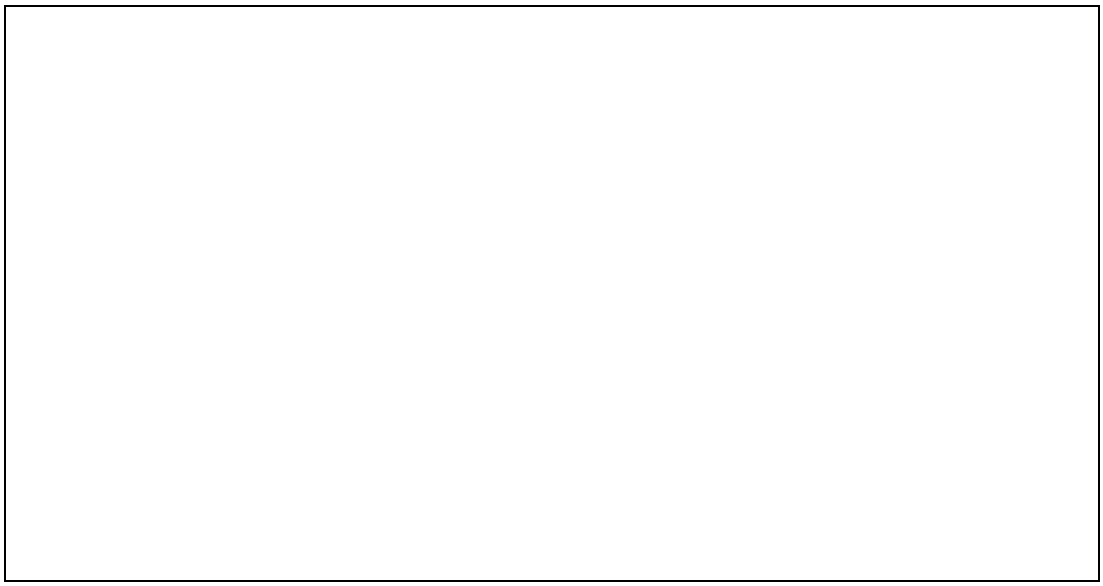

Figure 3.

Band by Band Comments

29.7-47 MHz — A useful band for radio microphones. Man made noise may be a problem.

47-68 MHz — Frequencies within this band are subject to Sporadic E and tropospheric interference. Large antennas are required if antenna gain or directivity is important. Smaller, but inefficient antennas, are acceptable for low power devices such as radio microphones and indoor communications.

	Man made noise can be a problem for programme quality circuits.
68-87.5 MHz	The main SAB use of this band is for communications related to programme production. In some countries parts of this band are also allocated to broadcasting.
87.5-108 MHz	This band is heavily occupied by FM broadcasting stations throughout most of Europe, and is consequently of little value for SAB.
108-136 MHz	The aeronautical band. The high protection requirements necessary for safety of life systems makes this band unsuitable for SAB.
136-174 MHz	Prime spectrum for those types of SAB operations which may be slotted in between existing allocations.
174-230 MHz	All types of SAB are currently accommodated between broadcast allocations on the basis of non interference to the broadcasting service. SAB use will decrease when the current proposals to use parts of the band for T-DAB are implemented.
230-400 MHz	Military usage. SAB use is confined to non NATO countries. Potentially of great value for SAB if a sharing agreement can be reached with the military authorities.
400-470 MHz	Popular band for programme and communications circuits.
470-862 MHz	Bands IV and V; most countries are able to fit all categories of SAB operation into these bands on a non interference basis to television broadcasting. Since such operations have to take account of existing broadcasting service areas SAB use is generally geographically restricted.
862-960 MHz	Only used by a few countries for SAB. Approximately 17 dB more radiated power is required to match the coverage obtained at about 140 MHz.

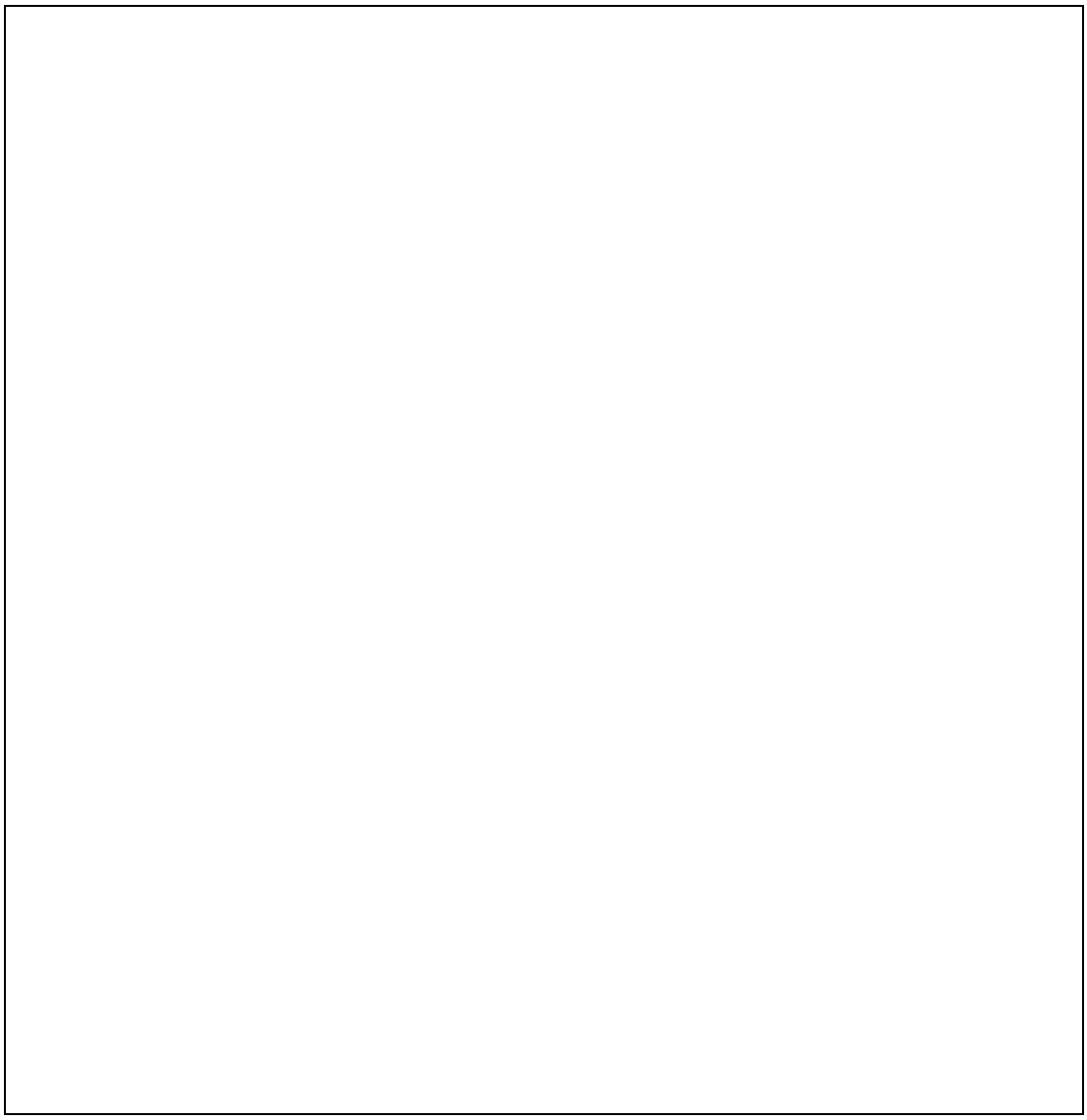

Figure 4.

7.4.2.2 Future Growth

As broadcasting becomes more competitive there will be a demand for more and better coverage at outside broadcast events and news locations. Initially, it may be possible to accommodate some of these requirements within the existing spectrum allocated to broadcasting. However, the expected introduction of digital television and the consequential increase in the use of the broadcasting bands could mean that in the short to medium term (i.e. in the introductory phase for digital broadcasting), the possibilities for this type of sharing will decrease. Also the expansion of mobile radio will have an impact on available SAB spectrum. In the longer term, when digital services replace the existing analogue services, sharing possibilities will again increase.
Another possibility to assist with SAB spectrum congestion, is the development of equipment employing spectrally efficient modulation techniques. This can only be considered a long term objective due to the higher power requirements, size and cost of digital circuitry together with the requirements for wide

bandwidth, high quality and length of operating time, coupled with the need to keep time delays as short as possible.

7.4.3 Harmonisation

As part of the future allocation of spectrum for SAB, it is considered necessary to achieve some harmonisation of frequency assignments and equipment types.

The benefits would include:

- access to low cost equipment;
- effective use of spectrum through common equipment standards;
- possibility for the free circulation of equipment between countries.

However, there are occasions when broadcasters from different countries wish to use their equipment at a common location (major sports events, state occasions, etc.) Under these circumstances, the harmonisation of frequency bands simplifies overall spectrum management but requires careful assignment planning to avoid mutual interference.

If the harmonisation of frequency bands for SAB can be achieved, there could be a reduction in the number of bands in which SAB sharing would be needed.

7.4.4 Sharing

Wherever possible, the potential for sharing within the terrestrial broadcasting bands has been exploited. In many countries, most of the requirements for SAB can be met by sharing spectrum in the broadcasting bands. However, because of the various broadcast channel assignments, and differing channel widths currently in use for broadcasting within Europe, there is little consistency in the allocation of frequencies for ancillary services.

The use in each country has been determined by the ability to ‘slot in’ ancillary service requirements. Much of the spectrum allocated is unsuitable for any other use or is subject to geographic restrictions. The demand for indoor (studio) applications can only be met by exploiting broadcasting spectrum.

Planning the spectrum used for television broadcasting is a complex matter, requiring a detailed knowledge of existing and proposed television coverage. Sharing criteria are currently available in the Draft revision of Rec. ITU-R IS.851. Typical temporary applications, planned strictly on a non-interference basis to broadcasting, include programme links for outside broadcast locations and extensive use of studio radio microphone and production talkback facilities. At the other end of the scale detailed planning studies in the UK have demonstrated that the potential for higher power (> 5 watt) operations within Bands IV and V is very limited; even if all of the television channels are considered for five watt operations there are parts of the UK where no SAB assignments within Bands IV or V would be available. This is partly due to the

fact that the television system used in the UK uses all of the bandwidth available within the 8 MHz channel. In any event the possibilities for sharing with the broadcasting service in the UHF bands throughout all of Europe will drastically decrease when digital television, needing a bandwidth of 8 MHz, is introduced.

In some countries, SAB use military spectrum on a geographically limited basis. It has also been suggested that greater use be made of pre-emptive management techniques (i.e. the military have primary access to the allocations in times of national emergencies or war) as a means of increasing the sharing of military mobile bands with other civil services such as temporary outside broadcast links.

7.4.5 Future Bands for Services Ancillary to Broadcasting

The situation for SAB in the DSI Phase II frequency range will not be particularly easy in the forthcoming decades if the envisaged transition to digital television occurs. This is because the majority of SAB operations take place inside the traditional broadcasting bands and it is believed that wherever possible, this practice should continue.

The DSI Management Team have recognised the increasing requirement for SAB equipment to roam relatively freely across national boundaries especially within the CEPT.

It is therefore recommended that every effort should be made to harmonise SAB frequency allocations and equipment parameters.

In many instances, regardless of geographical location, defence and SAB can be considered as temporary, yet both defence and SAB users when a need occurs, require as much spectrum as possible to be readily available.

For this reason the DSI Management Team recommend that when the use of broadcasting spectrum is not feasible, the bands primarily identified for defence applications might be considered for SAB on a pre-emptive basis, with geographical constraints as necessary.

In addition SAB could be allocated slots in the bands 207.5-216 MHz (after the analogue to digital transition period), 406.1-410 MHz and 862-875 MHz.

Following the transition to digital broadcasting it is anticipated that sharing possibilities may increase although the intensity of use of the possibly reduced broadcasting bands is likely to be extremely high.

The DSI Management Team therefore recommend that following the transition from analogue to digital broadcasting, the future bands to be used for broadcasting should only be shared with services ancillary to broadcasting.

It can be seen from the foregoing that the position for SAB is somewhat uncertain, yet requirements will continue to grow as more cable and satellite broadcasters supplement the growing number of terrestrial broadcasters. It must also not be forgotten that SAB assignments are often used by independent programme makers and the motion picture industry. It is therefore necessary that national administrations and the CEPT carefully monitor the effect of harmonised bands, the benefit of sharing with defence users and the consequences of future digital SAB. A regular review of the needs of SAB is necessary. If required, consideration should also be given to use, in future, parts of the (then) reallocated broadcasting bands for SAB.

A two tier approach is believed necessary at a national and European level for this dynamic process of monitoring, (re)allocating and assigning SAB bands and frequencies.

The DSI Management Team therefore recommend that national SAB structures should be established to monitor, co-ordinate and rapidly respond to SAB requirements. Further, arrangements should be instigated to meet the needs of SAB users crossing national borders. The DSI Management Team recommend that the ERC consider in due course, the establishment of a joint CEPT/EBU SAB forum. This combined forum should manage the dynamic process of allocation and reallocation of SAB frequency bands and assignments, monitor the overall requirement for SAB and advise on all other regulatory and operational aspects in relation to the successful operation of SAB in Europe.

8. Mobile Service

The development of mobile telecommunications is still only in its infancy in a number of countries in Europe whilst at the same time it is one of the first of the telecommunications services to be affected by the general movement towards liberalisation. As noted by several observers, this movement is largely motivated by the worldwide swing towards service-based rather than hardware-based purchasing by users of telecommunications products. What is significant is that this trend is proceeding independently of national telecommunications policy setting procedures.

A potential result of such a situation is a large diversity in the demand for and supply of new services, including those provided through national mobile networks, together with a likely increase in the demand for international networks.

The worldwide market for all 'mobile' communications is estimated to have a growth rate of 8% year-on-year without any indication as to what the limits (if any) to this expansion might be.

The implication of these factors on spectrum management is that traditional approaches might have to be reconsidered in the short term, in order to be able to respond appropriately to the rapid growth in the demand for mobile services.

It should be noted that the frequency range of this DSI does not include the majority of mobile satellite communication networks, systems at 1800 MHz or future systems in the vicinity of 2000 MHz. The majority of contributions referred to traditional public networks (mainly in the 900 MHz range) or private networks.

The current situation and possible evolution of mobile networks are examined in detail in the following pages, but it is considered necessary at this stage to clarify what is meant by 'public' and 'private' networks since differing political emphasis is placed upon the provision of spectrum for each category by various administrations.

It is believed that use of the word 'public' within the context of mobile radio networks can and does cause considerable confusion. For example, PAMR (Public Access Mobile Radio) is a relatively recent addition to the European vocabulary, but the 'Public' of PAMR is a misnomer in that it neither guarantees connection into the PSTN/ISDN in every country, nor provides the capability for any member of the public to talk to any other member of the public.

8.1 Definitions

In order to improve the understanding of the differences between non public and public mobile systems this section provides some background to the definitions that the DSI Management Team have applied to the two categories of mobile radio.

8.1.1 Non Public Mobile Radio

Until recently, communication within Private Mobile Radio networks was restricted to communications between members of individually licensed, closed user groups.

The evolutionary broadening of the regulatory environment has now altered this situation to the effect that users often can now subscribe to a service-provided network, buying the hardware, coverage and special facilities desired whilst sharing the infrastructure with others. Such service-provided networks may range from a single common base station (CBS or Community Repeater) with limited coverage of a few kilometres around a single site at one extreme, to complex trunked national networks at the other, all falling under the mantle of private mobile radio.

A suggestion was received to retain the title of PMR since its use is so widespread, but to adopt a modification of the initial letter to mean Professional rather than Private as a means to lessen confusion. The resulting term Professional Mobile Radio can therefore be employed irrespective of whether a network is self-provided or service-provided and even more importantly can be used to cover the existing so-called Public Access Mobile Radio (PAMR) services. Though these include the word ‘public’, they are essentially intended to provide professional communications within a closed group and have little of the extended PSTN/ISDN element of the true ‘public’ cellular networks.

Arguments that PAMR services should also be in the ‘public’ category simply because they can access the PSTN/ISDN or be easily obtained from a service-provider without extensive licensing procedures are difficult to justify for these are merely secondary aspects to PAMR's primary goal to provide better coverage for closed user groups.

This DSI has therefore adopted the term PMR (Professional Mobile Radio) to cover mobile radio services as distinct from public cellular networks, irrespective of whether self or service-provided, single base station CBS or national trunked networks or whether connected to the PSTN/ISDN or not.

8.1.2 Public Mobile Networks

The use of the word ‘public’ when used with reference to public cellular networks is easily and universally understood. It implies a mobile extension of the wire-based telecommunication system, the PSTN/ISDN, through which any member of the general public may communicate with any other member of the general public.

Public mobile networks are those which are, in effect, extensions of the PSTN/ISDN. It is likely that over time the distinctions will become blurred as we approach the era of FPLMTS/UMTS* , but whilst the current disciplines of frequency allocations exist, we consider the separate descriptions of public and private to be appropriate and meaningful for all concerned parties.

8.1.3 Classification of Mobile Networks

For political reasons, administrations find it important not only to differentiate between the quantity of spectrum allocated to public systems compared with professional (private) systems, but to differentiate also between shared and non shared systems under the professional heading.

It is therefore important to be clear how individual administrations categorise public and private services and to attempt some consistency with their descriptions. It has been difficult to extract such information from contributed documents and accordingly statistics which seek to compare the two must be carefully examined.

Furthermore, depending on the country, networks used for services such as Police, Fire, Ambulance etc. are either assigned frequencies in the general PMR bands or are allocated specific frequency bands. Such differences must be taken into consideration when discussing figures concerning the total amount of spectrum available for mobile applications.

Notwithstanding the spectrum implications, the following terminology has been applied where appropriate throughout this document:

> '**SELF-PROVIDED PMR**' refers to closed user-group mobile radio networks with **self-provided infrastructure only**, irrespective of coverage area or whether trunked or not.
>
> '**SERVICE-PROVIDED PMR**' refers to PAMR (trunked systems) and CBS (common base stations or community repeaters).

Connection to the PSTN/ISDN, whether freely available or in some way restricted, will have no influence on the above categories which are characterised as primarily closed user-group networks.

* FPLMTS - Future Public Land Mobile Telecommunication Systems
UMTS - Universal Mobile Telecommunications System

8.2 Professional Mobile Radio (PMR)

8.2.1 Scene Setting

Until the 1980s a professional network was normally configured with a single base or repeater station located on a high site. Analogue modulation (amplitude, frequency or phase) would be employed. Two frequency simplex or duplex systems were generally utilised which helped to maximise the use of the high site.

Such systems provided service to about 80 mobile terminals with a service area extending about 30 km radius. PMR systems mainly provided voice telephony with push to talk operation, although some data services were established using modems in the voice channel with proprietary standards and protocols.

During the past 10 years the PMR concept has tended to develop in a similar direction to Private Branch Exchanges in the fixed wire network for example:

- Powerful digital switches provide for the sharing of several channels on a single site, according to the traffic density, for the interconnection of sites and for connection to the Public Switched Telecommunications Network (PSTN-ISDN) when needed;
- Sophisticated digital modulation techniques (non constant envelope) together with signal processing at the receiver permits more channels in a given frequency band to be used and provides for improved immunity against interference;
- Fully integrated services using international standards (X25, X400 etc.) are provided together with telephony which remains nevertheless the dominant use.

In a similar fashion to the PABX market which remains dynamic even though the Public Switched Telecommunications Networks and ISDN may offer similar facilities (CENTREX and Virtual Private Networks), the market share for PMR is expected to grow in providing the very specialised services and operational facilities that a minority of subscribers require.

The domain of professional (private) mobile networks has for a long time been considered as a national issue and so far has only received limited attention from some CEPT administrations. This, added to the lack of a real European mobile users association dealing with the issue, has the result that most of the available material concerning the European ‘market’ originates from manufacturers.

The PMR market is therefore excessively fragmented and ‘the inconsistencies in PMR regulations and technical specifications in Europe brought about by administrations acting independently’ is quoted as one important question to be addressed in this DSI.

The information and data provided to the DSI did not permit an in-depth analysis of the current situation covering all CEPT countries and, in any case,

the large variety in usage, frequency bands utilised and general regulatory situations would makes such a study rather difficult. However the DSI Management Team were of the opinion that it would be worthwhile considering a separate study on the subject to gather statistical information concerning 'model' areas with high populations and significant economic activity. Statistics concerning the number of installed base stations, number of mobiles per channel, average loading per channel, criteria used to measure the channel loading, principles for channel assignment, the different types of professional users and associated traffic characteristics, growth rates noted so far and those expected in future for different types of users and networks would be of particular value.

8.2.2 European Harmonisation

Harmonisation of frequency bands for the professional networks is strongly supported by European industry but it is also to be remembered that channel spacing, duplex spacing, transmit-receive positions etc. are spectrum management parameters which need to be taken into account in order to give full effect to harmonisation. This question has already been addressed by the CEPT and Recommendation T/R 25-08 (Co-ordination of frequencies in the land mobile service in the range 29.7-960 MHz) actually provides detailed information concerning harmonised parameters, for example duplex spacing and location of base station transmit and mobile station transmit sub-bands. Annex 2 to Recommendation T/R 25-08 is reproduced below (figure 5) and was used as a reference, where appropriate, in the preparation of the Frequency Table proposed in Annex A to this Results Document.

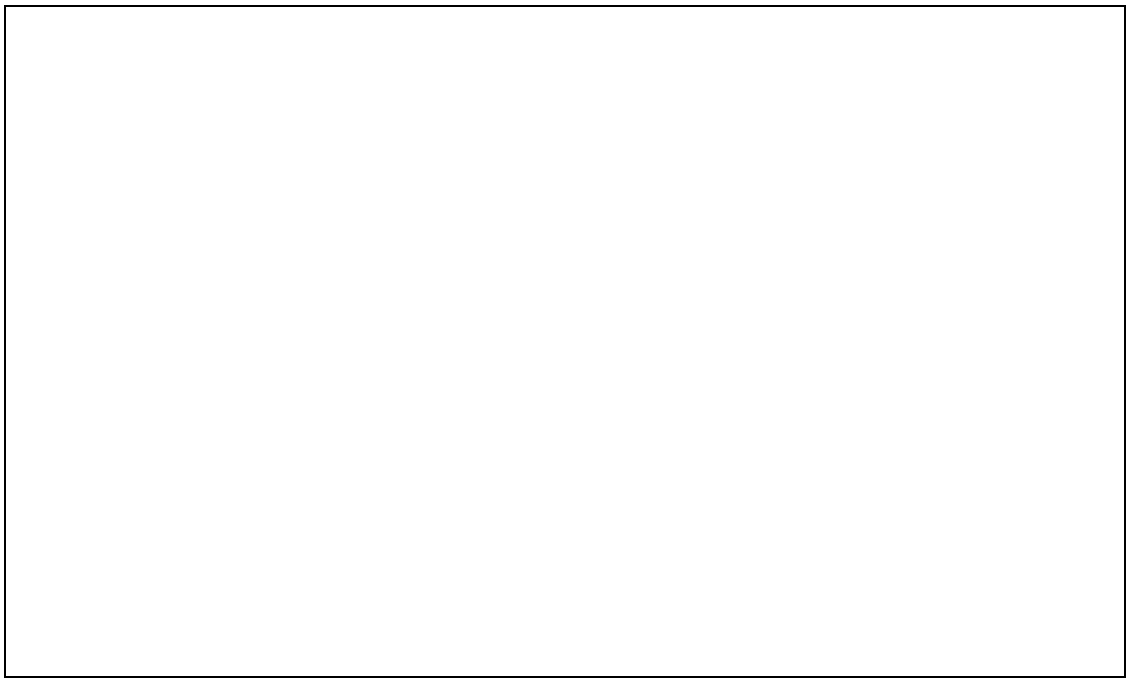

Figure 5.

More generally, it is felt that the CEPT should give more attention to the professional mobile radio sector in Europe and provide this community with an adequate and harmonised regulatory environment. Reference is regularly made to the US market recognising however that conditions are different in

Europe (population distribution, density of the public fixed network etc.) and that any comparison should take these differences into account. US penetration rates are much higher than those in Europe (5% in comparison with rates generally lower than 1.5%) however these rates might be considered an indicator for future developments in Europe.

The imminent transition from analogue to digital is the subject of various studies and plans for the allocation of spectrum for professional networks in many CEPT countries but, according to the contributions provided by national administrations, such plans are established on a national basis, without general co-ordination at the European level. However, several administrations mention the importance of integrating their national plans in a co-ordinated European framework. One typical example is the future trans European TETRA system for which the 400 MHz range is planned in most countries and the 900 MHz range in some others (CEPT Recommendation T/R 22-05 gives an indication of the frequency bands from which these choices have been made).

One can sum up these preliminary remarks addressing the contributions by saying that there is a strong desire for improved co-ordination within Europe concerning the regulation of professional mobile radio networks, including spectrum harmonisation. Since the introduction of digital equipment will often necessitate changes in spectrum allocations at the national level, European harmonisation is an opportunity to be taken without further delay otherwise the level of harmonisation to be achieved within CEPT countries may be somewhat lacking.

It is recognised that this will be a very difficult task and that its successful achievement will on occasions require support at the highest level in the national authorities. The agreement within CEPT on a common frequency band for TETRA between 380 and 400 MHz is an example of what can be achieved when such support exists. It is thus believed that harmonisation in the field of civil professional mobile networks is desirable and possible.

The DSI Management Team therefore recommend that the harmonisation of professional mobile radio networks' regulations, including spectrum allocations, should be considered as a matter of priority and urgency by the ERC.

It should be noted that action in this domain is already proposed by the European Commission in the 'Mobile Green Paper' where the lack of a consistent approach and common principles regarding service provision is considered as a significant obstacle in slowing down the further development of the mobile market.

8.2.3 Self-provided PMR

Under this heading, only self-provided networks are considered, irrespective of whether they comprise single base stations or utilise wide area trunking techniques.

The large majority of networks can be included in the two following categories:

- **large networks**, typically more than 300 mobiles in densely populated areas, operated by public utilities for example, urban transportation, railways, power suppliers, large industrial sites etc. with specific requirements which include limited usage of the public networks. Growth of this type of network is expected to continue in future, at a rate of about 7%.

- **small networks**, less than 50 mobiles, operated by entities such as security (private), taxis, vehicle recovery services, business etc. Considering that this type of usage is currently not wide spread in Europe it will undoubtedly increase yet the rate growth may be reduced by a general migration towards the cellular networks. It is therefore expected that the number of small networks will change very slowly. It is often said that a decrease in such networks is expected, but no clear evidence of either an increase or a decrease appears in the contributions.

Representative associations, users, industry and administrations firmly believe in the continuous need for small networks. Public network operators however believe that similar functionalities will be provided by the public network at competitive costs and consequentially expect a large migration to these networks by conventional PMR users.

Estimates concerning the evolution of the self-provided PMR market vary greatly from one study to another. Differing views on the respective market share between self-provided and service-provided PMR can partly explain these variations. However, estimates concerning the total requirement for self-provided and service-provided professional mobile radio are more convergent and lead to similar conclusions in terms of the overall spectrum requirement.

8.2.4 Service-provided PMR

Under this heading, only networks provided to third parties are considered, short duration calls are assumed.

Contributions from administrations show that licensing conditions and the development of PAMR/CBS networks vary considerably within CEPT countries. Improved spectrum utilisation, easier frequency management, better quality of service, increased competition and liberalisation are factors which are prioritised in accordance with national policies.

In some countries, where connection to the PSTN/ISDN is possible, PAMR/CBS is considered as public mobile radio and as a possible future competitor to the cellular networks. The ‘Mobile Green Paper’ also introduces PAMR as a public mobile service. In other countries, PAMR is considered as PMR, i.e. professional use within a closed user group, with additional features (such as connection to the PSTN/ISDN) which are left to the service provider to develop and exploit.

As a result, estimates of future spectrum requirements for the PAMR networks vary according to the overall scenario chosen for self-provided PMR networks.

8.2.5 Spectrum Requirements

As mentioned above, data provided to this phase of the DSI does not always converge, unless the total market for professional networks is considered as a whole. In that case, estimates from manufacturers, users and administrations lead to similar conclusions, a minimal global allocation of 115 MHz for professional mobile radio networks in the year 2008, i.e. approximately 15 years hence.

It is necessary to stress that all estimates take into account technological development, digitalisation of networks, narrow band techniques etc. which will influence PMR in the next 15 years.

Generally, growth estimates for the whole PMR market fall within the range 2 to 10%. Large variations exist in the estimates concerning the share between self-provided PMR and PAMR. Furthermore, the development of PAMR is recent and the European experience in this domain is so far quite limited.

However, according to the majority of contributions which included figures on market development, the growth rates for self-provided PMR are forecasted to decrease (or even become negative) in future. Estimates vary from +7% to -5%. They are closely linked with estimates concerning PAMR which vary from 0% to 50% in the various scenarios detailed in the contributions.

This uncertainty concerning the market share between self-provided PMR and PAMR certainly does not ease spectrum planning if it is assumed that specific frequency bands should be allocated to PAMR. However, only one contribution has mentioned the difficulty of finding a balance between self-provided PMR and PAMR spectrum allocations. The DSI Management Team therefore assumes that the methods of frequency allocation are sufficiently flexible to allow necessary adjustments as a function of market evolution.

Estimates in contributions concerning the general spectrum allocation for professional networks did not always refer to the same period of time and thus a medium term figure has been assumed which falls between data addressing the years 2003, 2005 and 2008 chosen by different contributors. Taking the year 2008 as a reference, one can find converging views concerning the expected spectrum requirement; figures range from 100/130 MHz (115 MHz on average) for a low predicted growth scenario, to 130/160 MHz (145 MHz on average) for a high predicted growth.

Such spectrum requirement estimates are of course valid with regard to the situation in areas where the traffic is the heaviest, i.e. the centre of cities, airports etc. Higher estimates were given in the case of the very large European conurbations.

On the basis of these scenarios, it can be assumed that a total allocation of between 115 and 145 MHz for professional mobile radio will meet most of the market demand for such systems in CEPT countries.

The DSI Management Team agreed that a 115 MHz allocation for Professional Mobile Radio was a reasonable evaluation to be taken into consideration for the year 2008 and this has been reflected in the annexed Frequency Table. However, uncertainty inherent in any long term forecast (e.g. the impact of the economic situation) has to be recognised and periodical reviews of the amount of spectrum available for PMR should be made at least every 5 years.

The DSI Management Team recommend that a minimum of 115 MHz of spectrum should be available for PMR in the major conurbations of Europe.

New advanced mobile radio requirements do not feature in this estimate. Traffic related to the transmission of still pictures or slow motion video, for example, is expected to increase spectrum needs in the future. The few views expressed in input material concerning the percentage share of the total market for such facilities differ significantly and thus make estimates on a European scale rather difficult to quantify.

Entering into greater detail on the question of spectrum requirements, particularly the respective allocations to be determined for self-provided PMR and PAMR, necessitates further investigation. Concerning PAMR, existing or planned allocations in the largest countries total approximately 40 MHz. This does not include all potential users of the TETRA system (e.g. Police) but corresponds to the estimates made by ETSI for the likely use of the TETRA system. In some smaller countries, allocations of between 10 and 20 MHz are already planned, although these do not always include the emergency services.

It can be concluded from these figures that a 20 MHz allocation for TETRA will not meet all the national requirements in Europe but could be considered as a minimum common bandwidth to be harmonised within CEPT countries. Harmonisation of an additional 20 MHz should be the goal for the most densely populated European areas.

8.2.6 Frequency Range

A number of contributions have tackled the question of the frequency range to be used for such applications. With the exception of the band 380-400 MHz agreed upon by CEPT (see Recommendation T/R 02-02), it appears that there is no general agreement on another band.

Eight administrations have provided information on their plans for TETRA allocations, 5 of which are planning to utilise frequencies below 470 MHz whilst 3 envisage using the 900 MHz band.

A large majority of contributors (including those from European industry, the GSM operators, ETSI and some users) are in favour of allocations below 470 MHz, the current lower limit of broadcasting Band IV. Many reasons are given to justify this choice, including propagation factors and other techno-economic constraints relevant to PMR networks. These include the necessity of limiting the number of new applications in the 900 MHz band, thus concentrating public networks at 900 MHz (and above) which would lead to a progressive withdrawal of public networks from the 450 MHz range.

Difficulties are likely to be encountered in the harmonisation of spectrum for private networks in the short term. However, it is believed that after a period of 15 years during which an important part of the installed base will change from analogue to digital, some progress will be possible. Consideration should also be given to future developments in broadcasting which, in the longer term, following the transition period are likely to provide new possibilities and may allow a readjustment of allocations between TV broadcasting and e.g. the mobile service.

It is now necessary to examine the possibilities for increased allocations for professional networks and for a harmonised set of core bands. The traditional bands currently used for these networks fall within allocations at 68-87.5 MHz, 146-174 MHz, 410-430 MHz and 450-470 MHz; these bands are therefore logically designated as candidates for future harmonisation. To this list, should be added bands in the vicinity of 30 MHz and 900 MHz which are also used for PMR in some countries.

The partial use of the current broadcasting Bands I and III for mobile services cannot be envisaged in all countries in the short term, nevertheless, in the very long term (circa 2020) this becomes a possibility. Such a scenario could also apply to broadcasting Bands IV/V, the lower limit of which for example might possibly be changed from 470 MHz to 510 MHz following the transfer of television broadcasting from analogue to digital modulation techniques (see section 7.3.3).

An average of 50 MHz is currently allocated in European countries to professional mobile radio, the largest allocations being around 80 MHz (including bands for PAMR service providers). The comparison between these figures and the estimates concerning future requirements leads to the conclusion that spectrum allocations will have to be approximately doubled within the next 10 to 15 years. In other words, an additional allocation of 65 MHz has to be ‘found’ to supplement the existing 50 MHz. It is proposed to focus attention on the following bands, keeping in mind that some of these suggestions should be understood as falling in the long term scenario:

47-68 MHz (Broadcasting Band I)

This band is a candidate band for mobile services (see section 7.3.8). It is already allocated to the mobile service on a permitted basis in a number of countries (see ITU RR, Article 8, footnote 554).

68-87.5 MHz

This band is already largely used for PMR, either with exclusive national allocations or shared with defence.

146-174 MHz

This band is currently used for PMR and should remain one of the core bands for this service.

174-230 MHz (Broadcasting Band III)

This broadcasting band is already used in some countries for land mobile. It is allocated to the mobile service on a permitted basis in a number of countries (see ITU RR, Article 8, footnotes 621-622). However, this is not the general case and the use of part of this band for mobile applications cannot be generally expected in Europe until analogue television broadcasting ceases after the transition to digital. In any event the band 216-230 MHz will be utilised for digital audio broadcasting, the future PMR band may therefore be limited to 175.5-207.5 MHz partially in accordance with CEPT Recommendation T/R 25-05.

380-400 MHz

Discussions concerning the 380-400 MHz band for TETRA are not yet finalised but it is clear that this band offers the unique possibility of a harmonised European allocation in the very short term (see section 9.7).

410-430 MHz

The use of this band is not fully harmonised in CEPT countries. It is widely used for PMR in some countries, but is also allocated to defence in other countries with opportunities for sharing with PMR in large cities. This band is included in CEPT Recommendation T/R 22-05 for TETRA systems.

450-470 MHz

Also mentioned in T/R 22-05 as a candidate for TETRA systems, this band currently hosts the analogue NMT 450 public networks in a number of countries (see figure 8 in section 8.3). The transfer to digital systems is expected to progressively create opportunities to develop new harmonised systems, including TETRA.

The DSI Management Team recommend that the band 380-400 MHz should be designated for TETRA together with other sub-bands, within the bands 410-430 MHz and 450-470 MHz, on a European basis.

900 MHz range

This frequency band is generally not used for service provided PMR. However, plans made by some administrations concerning the use of trunked systems as well as discussions being held concerning the UIC's (International Railways Union) requirements, show that there is an interest in developing professional networks at 900 MHz. Furthermore, the above-mentioned estimated spectrum requirements for PMR are considered to be very difficult to satisfy below 500 MHz. For these reasons, an allocation of 2x5 MHz is proposed in the 900 MHz band for service provided systems of which 2x4 MHz is identified for the UIC. Obviously in geographical areas where the full UIC band is not required it could be utilised for alternative applications.

8.3 Public Mobile

The situation concerning public mobile services varies widely from one CEPT country to another and it is therefore rather difficult to identify common characteristics which could be representative of all national situations in Europe. This is clearly portrayed in Figure 6 below, which provides an overview of the evolution of cellular networks in some CEPT countries. The graph details frequency band information and the starting date of the main networks. Systems operating at 150 MHz are not included. Also provided is information concerning the general development of public mobile services in the same countries, taking the penetration rate for early 1994. Countries are listed in date order with respect to the opening of the 450 MHz networks and/or the penetration rate. Data concerning the growth rates for analogue and digital networks are not reproduced in this document but should also be considered in order to assess developing trends.

Figure 6.

As already indicated, there is no one typical European situation, however it is possible to define three categories where situations are comparable.

category 1 - situations with high penetration rates (approx. 5% to 12%) and as a consequence a relatively stabilised growth rate. The opening of the 'oldest' 450 MHz networks which are still in operation today generally took place more than 10 years ago. The rapid expansion of these networks quickly led to the opening of the 900 MHz 'analogue bands', which commenced in the mid 1980s .

The number of subscribers to the analogue networks is still increasing, at a high rate for the 900 MHz systems while the situation in the 450 MHz bands is either stable or declining. Globally, the analogue cellular networks in this category still absorb a significant proportion of new subscribers when compared with GSM networks. The exception however is in Denmark where today GSM seems to be the most popular public mobile radio system .

Future developments are likely to be characterised by a relatively slow change from analogue to digital technology , for example in the Nordic NMT networks where agreements between several countries have made international roaming possible, which is one of the GSM system's selling features. Of course, the operators' policy will be a determining factor in these developments, especially since in the majority of cases the operators of analogue networks also operate a GSM network, see also section 11.3.

In terms of spectrum use, the traffic increase in the 'digital bands' will be related to the traffic decrease in 'analogue bands' although new market sectors are being opened up by GSM operators. One might therefore expect a natural and co-ordinated, but slow migration to the digital bands.

A similar conclusion would also apply to some extent to the TACS 900 MHz networks.

category 2 - situations with medium penetration rates (approx. 1% to 5%) and a large market in full expansion. Analogue networks in this category were installed more recently (1985 -1990 for the 450 MHz band and 1989 -1993 for the 900 MHz band). Generally, the situation in the 450 MHz bands is either stable or declining to the benefit of the 900 MHz systems. Two different cases exist in the 900 MHz bands and are described below:

- case 1: GSM networks are operational in the presence of limited analogue networks which are also operating at 900 MHz. In this case, for several reasons including the limitation of spectrum resources, one might expect the digital systems to become very quickly the main systems (France and Germany count together for more than 2 million GSM subscribers from a total of 3 million*). As a consequence, the transfer from analogue to digital could be relatively very fast. The availability of the digital bands is of particular importance in this situation.

- case 2: 900 MHz analogue networks are well developed and GSM is not, or only partially operational. Several analogue networks started around 1990 and represent today a large number of subscribers (Austria, Italy, Netherlands and Spain count together for more than 2.7 million analogue subscribers). It is therefore obvious that such networks, because of their immaturity will still be operating for a long time and the transfer from analogue to digital will probably take longer than in case 1. However, the relatively low penetration rates, compared to the rates mentioned in category 1 (Nordic countries), leaves a large open market for possible new subscribers and the GSM operation is expected to develop at a good pace.

category 3 - situations with low penetration rates (less than approximately 1%): most of the modern networks in this category are new 450 MHz analogue networks, generally installed after 1991. In the long term, these networks will be the last in operation in the 450 MHz range. However, digital systems are in the process of being installed and will compete directly with the analogue networks. How the competition will develop between digital and analogue is difficult to determine. Relevant factors include market development, the number of licensed operators and their commercial policy and the evolution of the cost of equipment, etc.

This simplified overview of the situation shows that the evolution of public cellular networks in the various CEPT countries is not converging in the short term and that it might take a long time before such convergence occurs.

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* Figures mentioned in this chapter reflect the situation at September 94 and are likely to be considerably different by the time this report is published, especially in the case of GSM networks.

Figure 7 provides a picture of the situation concerning the age of various mobile networks projected to the year 2008, the reference date for this DSI. It is based on the start up date of each network. Obviously, one should also consider network extensions made subsequent to the first launch of service, before drawing any conclusions from this chart.

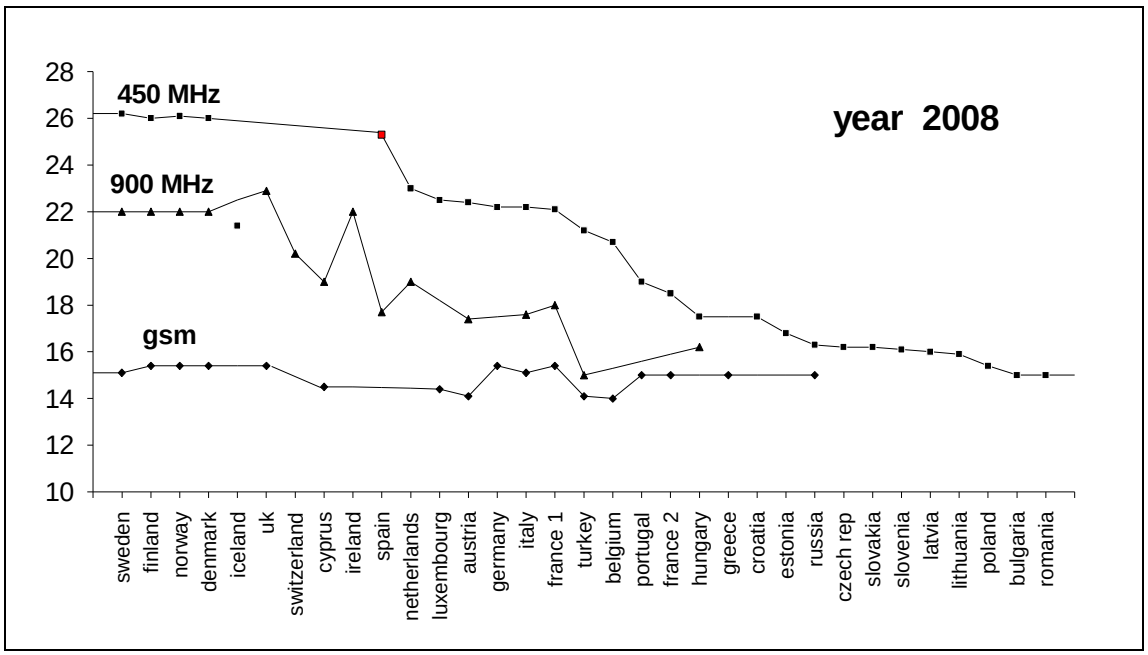

Figure 7. The age of the public networks in year 2008

450 MHz

However, taking additionally into consideration statistics concerning the evolution in the number of subscribers for public networks, one could expect that a large number of analogue networks at 450 MHz will be phased out significantly earlier than the year 2008, with the exception of eastern European networks where existing 450 MHz networks have been implemented only recently and may be expected to continue up to the year 2008. In this case, the development of GSM networks will be a determinant factor concerning the future conditions of use of the 450 MHz bands.

Figure 8. below demonstrates the current use of the 400 MHz bands for public networks in several countries. The expected progressive release of these bands will provide an opportunity for new services to be introduced in a harmonised way. Figure 8 shows that in a number of countries frequency allocations for public mobile networks have been chosen from within the band 450-470 MHz. In other countries, this band (or part of it) is often used for PMR. Such a situation offers excellent conditions for the future development of additional pan-European systems and should be fully exploited.

Therefore the DSI Management Team recommend that an in depth study be conducted as soon as possible concerning the possibilities likely to

occur for PMR and other non public mobile applications through the decreasing use of the 450 MHz range for public mobile networks.

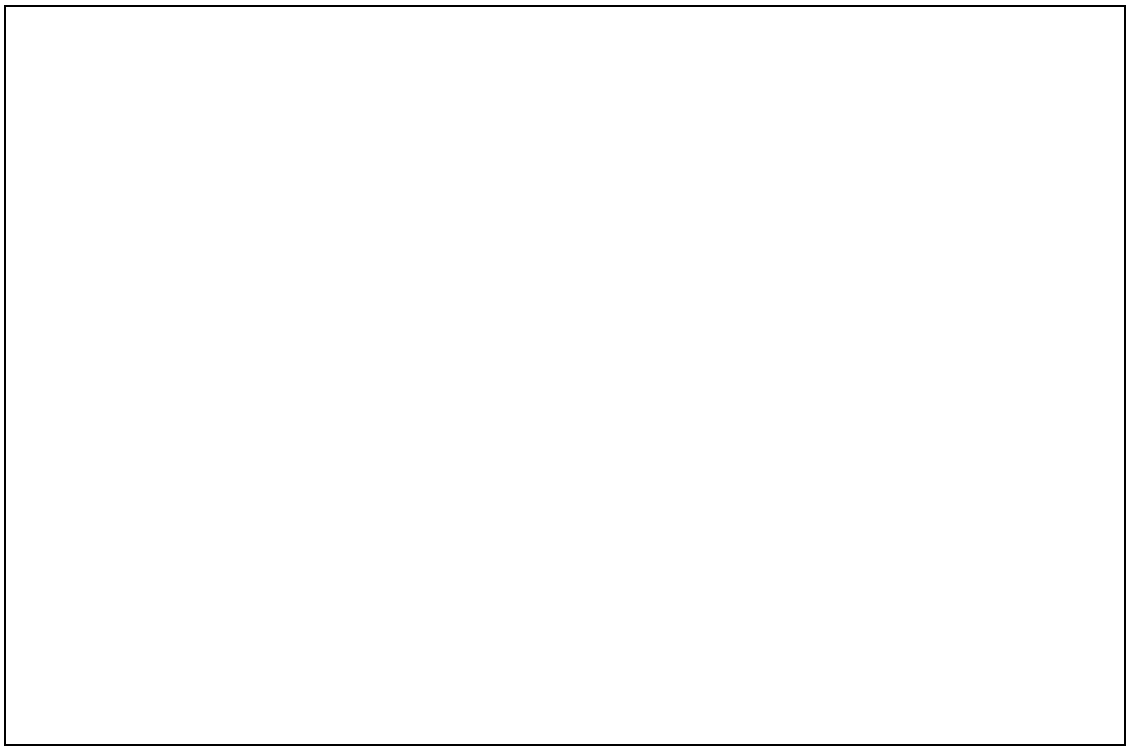

Figure 8.

900 MHz

It is expected that a number of analogue networks at 900 MHz will continue operation beyond the year 2000, in parallel with GSM networks. By the year 2008, all current networks would have been in operation for at least 15 years. However, they represent today approximately 6 million out of a total of 9 million analogue subscribers in CEPT. The analogue networks are still expanding despite the launch and popularity of GSM. Several networks are very recent and because of the heavy investment made by the operators, they could still be in operation in the year 2005 or even later.

Concerning digital networks at 900 MHz, the first GSM networks were launched around 1992 and progressively GSM is expected to become available in all CEPT countries. The oldest part of the oldest GSM networks will be only 15 years old in 2008 and it is certain that the GSM system will still be in operation at that time.

In the first half of 1994, the number of new subscribers to digital systems started to surpass the number of new subscribers to analogue systems in Europe. This is mainly due to developments in countries like France and Germany, an important part of the European market, where almost all new subscribers are connected to digital systems. The same situation exists in Portugal and Greece. Furthermore, in a number of countries using the 900 MHz bands for analogue networks, there was in mid' 1994 a very limited number of GSM subscribers. This is because GSM had only just been

launched in The Netherlands, had not been opened in Spain and was voluntarily limited in its development in Italy, awaiting the opening of a second network. It seems clear that the 'GSM-effect' is going to gather pace very rapidly after 1994 and that the 900 MHz bands could become congested and the situation somewhat difficult during the transition period from analogue systems to GSM.

In addition to this, in a number of countries 900 MHz analogue systems are operated within the GSM bands (see Figure 9 below). This creates some difficulty in finding adequate spectrum during this transition period.

This situation has led the operators to strongly recommend that consideration should be given to GSM extension bands (including a review of the DSRR allocation) and their harmonisation at the European level. This situation is reflected in the recommendation contained in sections 11.16 and 11.17.

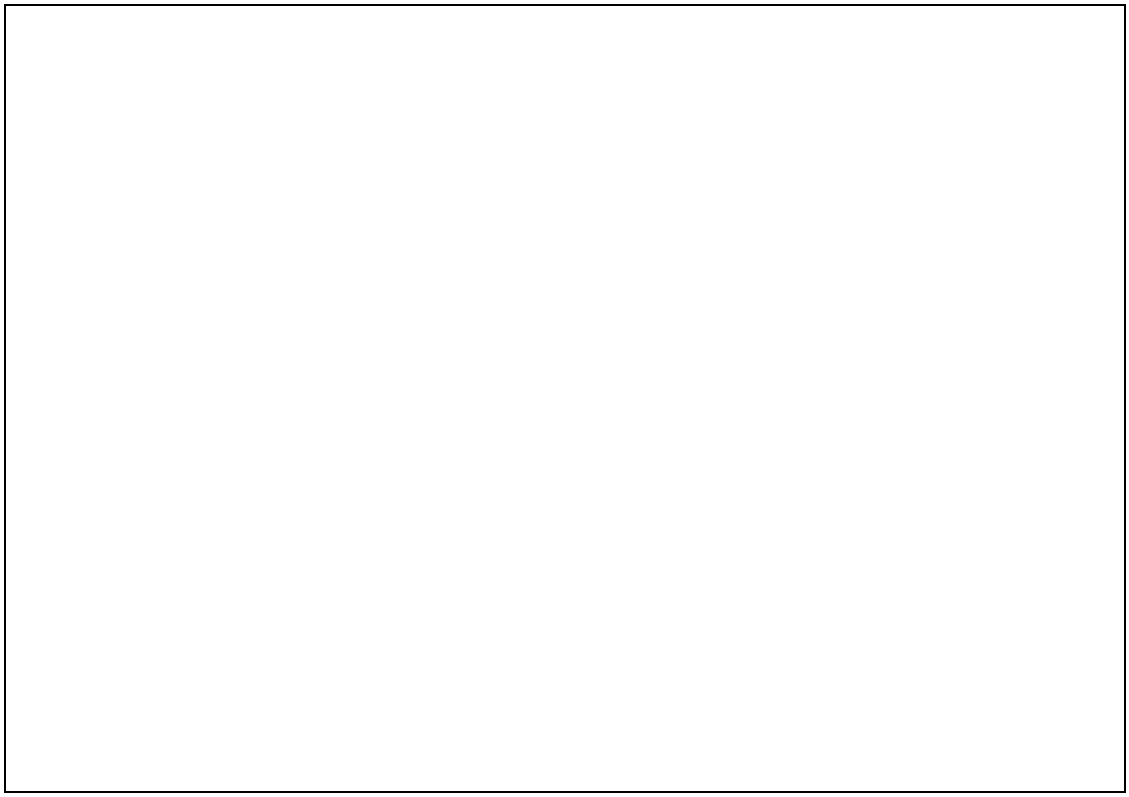

Figure 9. Current use of the 900 MHz for public mobile (GSM in black, analogue in white)

1800 MHz

DCS1800 digital networks operating at 1800 MHz based on GSM technology although outside the frequency range of this DSI, should be mentioned here as one element to be taken into consideration for the study of the future development of public networks.

As a conclusion, within the next 15 years, one can expect the 900 MHz range to be confirmed as the main range below 1 GHz for the operation of public mobile networks in CEPT countries. The use of the 450 MHz range will rapidly decrease, with the exception of Eastern Europe where there is open 'competition' between 900 MHz and 450 MHz systems.

8.4 Paging

8.4.1 On-site Paging

An on-site paging system is a privately owned and operated wireless communications system used in restricted and pre-defined areas with the primary function of alerting and/or contacting persons within the owner's premises. The air interface of the system comprises a single radio channel utilising at least one transmitter. Some of the existing systems also have a return frequency feature for call acknowledgement.

No official statistics are available on on-site paging equipment in Europe. In 1991 ESPA registered the annual sales of its members, (who represent 90% of the manufacturers) thus it can be estimated that approximately 4 million pagers are currently in use. Taking into account past figures and the influence of other telecommunication systems, it is estimated that there will be a population of 6 million pagers by the year 2000. It is expected that a lower growth will occur after the year 2000 and the maximum number of installed paging units will be 10 million.

A significant proportion of these systems are currently operated below the DSI range in the band 26.6 to 27.6 MHz. In the UHF band most systems are operated in the range 468-469 MHz. A survey made by ESPA showed that the total number of frequencies in use between 26.1 and 471 MHz is around 400.

From the industry's point of view there is a requirement to harmonise these frequencies in order to lower production costs. From an administrative point of view there is a need to define bands where this equipment can operate.

A well defined requirement was received from industry for these applications, based on the survey ESPA made in 1991. The original requirement, taking a theoretical worst case assumption and calculation, was 10 channels below 50 MHz and 10 paging channels + 12 return channels in the high VHF and UHF range. Calculations were based on a 9 frequency grid with a 500 meter separation. The input document from industry argued that the requirement should be updated to include 17 low VHF channels, 17 High VHF/UHF channels and 12 return channels. With 25 kHz channel spacing this results in a 1.15 MHz allocation for on-site paging.

It is recommended that the band 48.5-49.5 MHz be used as the main on-site paging band in accordance with the existing CEPT Recommendation T/R 02-01 and from within the band 403-404.5 MHz, 5

call-out and 5 talk-back frequencies should be chosen by the Working Group FM to be introduced on a co-ordinated and harmonised basis.

8.4.2 Wide Area Paging (Public Systems)

A lot of information and views were available from the operators and industry on the future of wide area paging. Unfortunately no information was provided by the major users of these systems.

Currently there are several national systems in use in Europe. Only two systems, Eurosignal (87 MHz) and Euromessage (460 MHz), offer the possibility to use the equipment in more than one country. In June 1994 the number of subscribers to wide area paging systems in western Europe was around 3.2 million corresponding to a 10% growth from the previous year.

If in future decades it is still considered that there is a requirement for national paging systems it is envisaged that these systems could be implemented and operated in the bands 138-142 MHz and 160.975-161.475 MHz.

Current systems are being threatened by cellular terminals which are getting cheaper and lighter. In addition special services within these cellular systems have become available, the SMS, Short Message Service in GSM being currently the best example. However, no voice or data terminal can yet compete with the portability and battery life of paging systems.

Paging utilising FM broadcasting transmitters is also in operation and such systems are expected to grow. New digital broadcasting systems currently under development also offer possibilities for wide area data services including paging.

ETSI has developed a technical standard for the European Radio Messaging System ERMES. The sixteen channels for ERMES are defined by an ERC Decision ERC/DEC/(94)02.

The ERMES system will be implemented on a pan-European basis and will it is believed fulfil the service and facilities requirements of most users. As mentioned earlier the system development is hindered by difficulties of using the designated frequency band in several countries because of incompatibility with broadcasting, cable TV and other radio systems. One contribution argued that there was a need for a separate national system using an alternative frequency range not necessarily based on the ERMES standard.
Some contributions indicated a need for a global paging system. The only system indicated in the contributions was proposing to utilise ERMES technology in the 900 MHz band. The DSI Management Team could not agree with the frequencies mentioned in the proposal. The DSI Management Team concluded that this matter should be discussed initially in a much wider arena, such as ETSI in order that a co-ordinated European policy approach to the future requirements for European and Global paging can be established.

In Europe, the existing wide area paging penetration is around 0.7 %, and one contribution predicted a ten-fold increase by the year 2008. The same contribution estimated that the number of potential customers to be found in the London, Paris or Rhein-Ruhr areas amounted to 25 million customers. With a penetration rate of 7% this would give 1.75 million subscribers. A traditional estimate of the capacity of one paging channel has been 100 000 subscribers, which indicates that the 16 ERMES channels would almost cover this scenario. In another document from an operators group an estimate of a total of 6.3 million subscribers in Europe by the year 2008 was given. With a uniform penetration across Europe this gives a much smaller penetration figure in the traditional European 'hot spots' of London, Paris and the Rhein-Ruhr regions.

The general trend in the contributions indicated that the number of subscribers in the current national systems would decline, although most subscribers would not be classified as international roamers or for that matter national roamers. Rather, paging will follow the trend of other forms of mobile communications, where for significant percentages of time the subscriber is located in the vicinity of his home or office premises.

The DSI Management Team concluded that the ERMES system operating in the 169.4125-169.8125 MHz band will fulfil the requirements of sub-regional, national and European wide area paging for the foreseeable future**.**

8.5 Wireless Local Loop (WLL)

8.5.1 Description

The key feature of Wireless Local Loop systems is to deliver telecommunication services by radio comparable to those provided by copper in the local loop. The aim is to provide competitive telecommunication services significantly quicker, with less costs for implementation and maintenance compared with wirelines to bridge the final gap between the customers location and existing or new exchanges (fixed public telecommunications network). The delivered telecommunication services shall be comparable in quality, performance, functionality, security as well as in service features and be compatible with Public Telecommunications Networks. In addition the WLL system shall support ISDN basic rate access.

8.5.2 WLL Systems

WLL systems are separated in *two groups one for rural areas and one for urban areas.*

WLL systems for rural areas bridge distances from the customers premises to the exchange or the central station of the WLL system and cover distances of up to 20 km. Access is generally provided by point to point connections.

WLL systems for urban areas are generally provided by point to multi point connections and bridge distances from 200 metres to 500 metres between

the customers location and the local exchange or some distribution frame depending on the system and its characteristics.

8.5.3 Modulation Techniques

WLL systems or other radio systems which are developed for different applications but can be used as WLL systems are operated with FDMA, TDMA and CDMA modulation techniques. Frequency bands are allocated below and above 1 GHz.

8.5.4 Implementation of WLL Systems

Urban Areas

For urban areas standardised systems like CT2 and analogue or digital cellular radio systems (NMT, TACS, GSM in the frequency ranges of 450 MHz, 800 MHz, 900 MHz) can in addition to their prime operational purpose be used as WLL systems. If such radio systems shall be used for WLL the frequency bands allocated for these systems should also be used for wireless local loop access. The regulatory and licensing conditions have to be developed and should ideally be agreed on a European basis.

In this context it has to be noted that radio systems such as DECT, DCS1800 and the Future Public Land Mobile Telecommunication Systems (FPLMTS) which are or will be operated above 1 GHz are also candidates for urban WLL systems, but this should be discouraged in view of the danger of the unacceptable loading of mobile networks.

Rural Areas

There are some WLL systems in the market place which are standardised as fixed radio service systems complying with national standards. Up to now these systems are operated in frequency bands above 1 GHz and are used by both European and non European operators. Results indicate that operators and subscribers are satisfied with the results obtained.

8.5.5 Standardisation

Since the implementation of telecommunication systems depend to a large extent upon economic factors the only viable solution is to develop European or global standards. The standardisation of all WLL systems by ETSI is supported by the DSI Management Team. A standard for urban and rural WLL systems should be available as soon as possible.

8.5.6 Frequency Allocation

As well as equipment standardisation the frequency allocation is of utmost importance for the implementation of WLL telecommunication systems,

sufficient spectrum is therefore needed to develop market potential and to give appropriate signals to industry.

Manufacturers have requested that - depending on the scope of operation (urban or rural) - frequency spectrum should be allocated below and above 1 GHz for WLL

The sharing possibilities between WLL and fixed and mobile services should be studied carefully since sharing between the fixed service and some WLL systems may prove difficult.

In a contribution from European industry the allocation of a harmonised frequency band for WLL systems in rural areas between 225 and 400 MHz was requested. In addition the operation of WLL systems between 790 and 860 MHz was requested on a temporary basis before the year 2008.

8.5.7 Examples of existing WLL Applications

The German unification and the need to improve the telecommunication infrastructure in the new Bundeslaender led to the implementation of so called 'cordless access lines'. These WLL systems are based on the NMT-900 technique and offer fast implementation of new access lines to the PSTN/ISDN. The project started in November 1991 and the first equipment was operational in April 1992. Around 40 000 subscribers are supported by these systems. The operation is temporary and should cease in 1998.

8.5.8 Conclusions

It seems that WLL systems have a potential market with respect to the planned liberalisation of the European telecommunication market and infrastructure as well as the urgently needed development of the telecommunication infrastructure in some eastern European Countries. WLL systems could therefore play an important role in fulfilling these objectives and demands.

It is therefore recommended that WLL systems in urban areas should preferably be based upon standards utilising frequency bands above 1 GHz, e.g. standards which are developed for the 3.4 GHz band.

In rural areas the bands 430-432 paired with 438-440 MHz and 450-460 paired with 460-470 MHz could be used for WLL systems on a secondary basis.

9. Defence

9.1 Introduction

Disregarding spectrum used by both civil and military aircraft for basic navigation systems and landing aids, defence appears to occupy around 30% of the spectrum between 29.7 and 960 MHz. Many have observed that much of it appears to be under used and should be transferred to civil users. This impression of under use may to some degree, be attributed to the nature of the defence requirement for radio. Training involves intensive but not necessarily continuous use of spectrum in peacetime and frequency bands which are used mainly for air-ground-air communication may seem deceptively quiet if observed at ground level. Nevertheless, recent changes in the world situation may justify reductions to be made in the spectrum retained for exclusive defence use, together with improved arrangements for sharing with civil radio systems and vice versa.

A major reduction in defence spectrum requirements would probably require changes in basic equipment characteristics. However, radio systems designed for tactical military use have to be highly resistant to radio noise and jamming, physically very rugged, compatible with earlier generations of equipment and inter-operable with the equipment of allies. These factors tend to make new types of equipment long in lead-time and expensive. At a time of extreme financial stringency, progress in increasing the efficiency with which defence spectrum is used is likely to be very slow, unless new arrangements for funding are feasible and can be practically implemented.

9.2 NATO

NATO is a defensive Alliance of 16 sovereign nations. The role of NATO has now been expanded to include support for peacekeeping activities, perhaps in support of the United Nations. High level political consultation on defence matters now includes co-operation partners who are 22 eastern and central European countries. The decision has recently been taken to extend co-operation to radio frequency matters.

Role of Allied Radio Frequency Agency, ARFA

ARFA is the specialised agency of the Alliance dealing with radio frequency matters located at NATO in Brussels. Decisions are made by the ARFA Plenary, by representatives from the NATO nations.

In 1951 the NATO nations decided

- to reserve 225-400 MHz for military use
- to appoint ARFA as the overall manager of the band
- to move military air-ground-air communications to this frequency band from the 100-150 MHz area

- to give responsibility to the ARFA staff for making the military air-ground-air assignments for the whole of NATO Europe.

The basic role of ARFA is to co-ordinate NATO use of the radio spectrum and ensure adequate access to the frequency resource to support military activities in Europe, but in the case of the 225-400 MHz band, it has special responsibilities.

A total of 168.1 MHz in the band 225 and 399.9 MHz has been placed by NATO members, under the control of the ARFA to facilitate co-operation within the Alliance. This arrangement is a key provision in the NATO Joint Frequency Agreement (NJFA). Management of eight sub-bands (the 'radio relay sub-bands') within the NATO band, totalling 55 MHz (60 MHz in the case of France) in bandwidth has been devolved back to the national defence authorities, subject to constraints. The remaining total bandwidth of 113.1 MHz is managed by ARFA on behalf of the Alliance.

The remainder of the spectrum used for defence applications is spread across the complete frequency range although several harmonised allocations have been agreed in all NATO nations. The individual frequency bands are discussed in more detail in the following paragraphs.

9.3 Non NATO Countries

As mentioned above, NATO is already addressing defence frequency matters with 22 co-operation partners. CEPT comprises NATO members, neutral and non-aligned countries together with eastern and central European countries that were former members of the Warsaw Pact military alliance. During DSI Phase I, it was determined to be important that an opportunity should be provided for the defence and civil frequency managers of CEPT countries to exchange ideas and information amongst themselves. Accordingly, a recommendation was proposed and subsequently implemented by the ERC that a mechanism be established for such consultations. An annual meeting organised by the CEPT now takes place which is chaired by the Chairman of the Frequency Management Working Group. It is hoped that non NATO countries and the CEPT will benefit from these important discussions.

9.4 Current Defence Spectrum Requirements

When discussing terminology especially in respect of defence applications, it is necessary to compare like with like. So called military radio relay or fixed requirements below 1 GHz are generally tactical and therefore of a transportable nature, hence the operational need for VHF spectrum in battle ground and exercise situations. In order to avoid confusion, bands that may be candidates for narrow band tactical applications in accordance with the definitions in the ITU Radio Regulations require allocations in the mobile service.

29.7-87.5 MHz

The main defence users in these bands are Combat Net Radio (CNR) and tactical transportable links generally operating on a single frequency basis. The requirement appears to be between 8 and 25 MHz and harmonisation of bands is desirable. The band 41-47 MHz is already harmonised for CNR purposes, for forward area voice and data communications. In addition, some narrow channels in the range 68-87.5 MHz are used by mobile users to gain access to tactical area communication systems operating within 225-400 MHz.

138-156 MHz
Within the range 138-156 MHz some countries see a continuing need for assignments for air-ground-air communication within the range 138-144 MHz. Spectrum between 138 and 156 MHz is used for a variety of mobile applications.

156-174 MHz
In addition to the use of Appendix 18 maritime channels, there is an ongoing requirement for sonobuoy operations at sea and in port.

225-400 MHz
Over the last few months, in depth discussions have taken place between NATO, civil and defence frequency managers in the process of revising the NJFA. Attention has focused on the band 225-400 MHz since the civil community has come to expect a ‘peace dividend’ following the easing of cold war tensions. The results of the discussions have been extremely positive, but in the light of the outcome (see section 9.7) and future sharing considerations, it is necessary to examine in detail the existing situation. Figure 10 provides an indication of the major NATO allotments within the 225-400 MHz band.

The air-ground-air sub-bands which amount to 84 MHz, are channelled at 25 kHz and contain conventional AM air traffic control and operational emissions (similar to those utilised for civil aviation) amounting to nearly 4000 assignments respectively in the UK, France and Germany alone, together with spread spectrum (frequency hoppers) capable of secure data and speech. The air-ground-air sub-bands in NATO countries are spread throughout the range 225-400 MHz in order to cause maximum difficulty in any scenario where communications are likely to be deliberately jammed. This spread is also necessary to accommodate multiple air-ground-air assignments co-sited at ATC and air defence transmitter sites. According to military sources, co-sited UHF assignments require a minimum frequency separation of 0.5 MHz.

55 MHz of the band 225-400 MHz is allocated for radio relay applications, mostly of a transportable and tactical nature. It is therefore within these bands that there may be possibilities for sharing with civil systems.

In addition to the applications described above various other current, civil and military requirements are accommodated in the band, including 15 MHz for mobile satellite applications, 6.8 MHz for ILS glide path and 5 MHz for TV broadcasting in some countries. Experimental T-DAB systems are also operating.

In non NATO CEPT countries, varying amounts of spectrum are allocated in this range for defence purposes. Most countries have an air-ground-air requirement in the band.

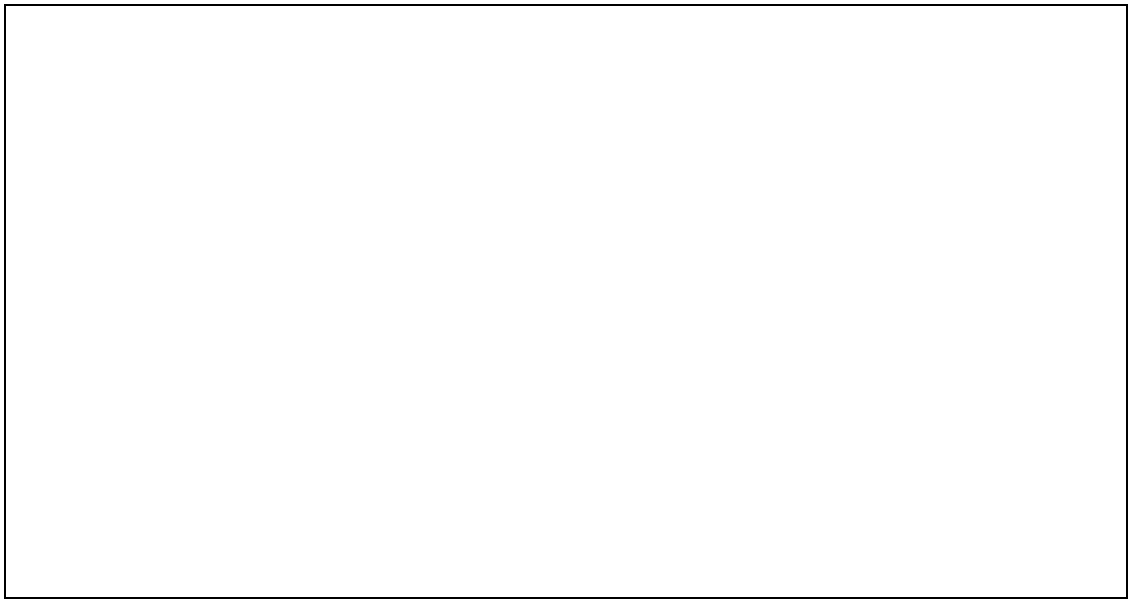

Figure 10.

400-470 MHz

In most countries the fixed and mobile use of the band would appear to be for administrative radio systems, similar to civil private mobile radio applications, although some countries have tactical transportable networks at their disposal.

Concerning other radio services, there is a requirement for naval and airborne radars over international waters and an additional requirement in a few countries, for land based radar, essentially for over the horizon detection of missiles and stealth aircraft. These currently operate within the radiolocation allocation between 420 and 450 MHz.

Bands between 400 and 410 MHz are often used by defence forces for met' aids and various mobile applications.

790-960 MHz
In this range there is a NATO military requirement for between 10 and 60 MHz for tactical radio relay, 10 MHz to be harmonised in border areas. In some other CEPT countries, in addition to the tactical mobile service requirement, various radionavigation and radiolocation systems may be found.

9.5 Current and Known Future Military Developments

Many are of the opinion that decreases in the tuning steps of aircraft radios will probably stop. This is due to the trend towards encrypted speech and fast frequency hopping where the bandwidth is at least 25 kHz, probably more. Also it is unlikely that finance from conventional sources is available for the necessary modifications to aircraft and ground equipment. However, there may be developments in civil ATC radios which have unavoidable knock-on consequences for the military that is reduced channel spacings (currently 25 kHz) in the shorter term, or in the longer term, the introduction of reduced channel spacing digital modulation techniques.

Further reorganisation of the band 225-400 MHz will be required due to the reduction in force levels in Europe and rationalisation of the NATO command structure. This will lead to the consolidation of airbases in NATO countries into fewer but larger sites. A small number of ATC assignments may be cancelled, but overall it is expected that the number of air-ground-air assignments will continue to increase as more flexible use of spectrum is demanded by the user and new concepts are introduced for the control of military aircraft.

A new single channel radio access equipment may also be introduced into the band sharing the radio relay channels.

Lastly, a multirole radio for army use is proposed which will tune over 225-400 MHz as well as the traditional 30-87.5 MHz band. The very wide tuning range of this radio and its antenna is likely to be technically challenging, but is probably unavoidable in order to find sufficient spectrum.

It is further anticipated that the frequency bands used by the NATO alliance will also be used in countries involved in the Partnership for Peace initiative.

9.6 Discussion

During recent years, there have been many discussions concerning the feasibility of sharing between civil and defence users, in some cases useful arrangements have been established, however the DSI Management Team have the feeling that these have been only token gestures, and in some CEPT countries progress in this regard could have been better. It is believed that more and extreme efforts are needed to enable defence users to have access to civil spectrum when there is an operational requirement, and conversely civil users should have access to defence spectrum, especially in the European population centres.

The basis for this reasoning is simple, in peace time, with the exception of air-ground-air and Earth to space satellite applications, intensive military operations take place in exercise areas. In most medium sized and large CEPT countries, these tend to be remote from major European conurbations; thus large tracts of spectrum should be available for tactical and mobile users without fear of upsetting civil users who should be able to use the same frequencies within an urban area.

On the other hand, defence requirements in the cities comprise administrative networks and training activities. It is suggested that the former can be incorporated into general land mobile bands and technical/operational mechanisms should be able to overcome the second need. It is now no longer acceptable to manage civil and defence spectrum in rigid and inflexible nationally allocated bands, more attention must be paid to providing assignments based on real requirements at the location in question.

The following opinions concerning current defence bands and recommendations covering the spectrum as a whole are intended to free spectrum above 60 MHz where there is an urgent need to provide more resources for civil users in the major conurbations.

9.7 Specific Spectrum Proposals

29.7-47 MHz

This band should generally remain for defence applications especially the band 41-47 MHz harmonised within NATO. However harmonised bands for civil (particularly low power) applications should be maintained and expanded if necessary, based on actual requirements (see relevant sections in this chapter) and agreed sharing arrangements which in many cases are already in existence.

52-61 MHz

This band should in the future be available for defence applications; in peace time activity should focus on exercise areas remote from centres of population. The band might also be used to accommodate some SAB applications on an occasional basis.

61-174 MHz

Many of the bands within this range have generally been designated in the European Table of Frequency Allocations for two frequency channels, each channel having base station transmit and mobile station transmit frequencies. New mobile radio bands identified in this range may initially provide ‘parking’ arrangements to allow administrations to rationalise more traditional bands and bring them into line with the European Table. Sub-bands within 61-87.5 MHz and 148-156 MHz have in the past been of interest to defence users. It is believed that a significant proportion of these bands could be available in remote parts of Europe, but in cities only a small portion is probably required for tactical applications. The DSI Management Team believes that administrative radio requirements should be provided at the assignment level.

Further, it might be beneficial to harmonise the details and use of any residual defence bands within the CEPT civil military forum.

Concerning the band 138-144 MHz, this is an allocation where a number of channels in some countries are used to supplement the band 225-400 MHz for operational air-ground-air applications on a national basis. It is therefore believed appropriate that the band for the off route aeronautical mobile service be reduced from 138-144 MHz to 138-142 MHz. Taking into account the developments in civil aviation concerning reduced channel spacing and digital solutions, it is feasible that future military aeronautical equipment could cover 118-137 MHz, 138-142 MHz and 225-400 MHz utilising a common channel spacing and modulation technique. For those countries which do not utilise the band 138-142 MHz at all for air-ground-air communications, the allocation should be available for a variety of terrestrial civil and defence applications. However with the possible exception of low power applications, these cannot be harmonised on a CEPT wide basis, since the aeronautical service will require protection in those few countries that see a continuing aeronautical requirement in this band.

225-400 MHz
Following extremely fruitful discussions, NATO agreed during Summer 1994 that:

- 225-230 MHz would be made available for T-DAB
- 230-240 MHz is still under discussion for T-DAB, but in the meantime civil usage is possible based on national agreements
- 380-400 MHz a phased entry of emergency services would occur until 2 x 5 MHz is provided with a duplex spacing of 10 MHz
- the principle of sharing with HAVE QUICK II frequency hopping system in 380-400 MHz was accepted.

It is further understood that NATO has agreed for the initial implementation of TETRA Emergency, that commencing in 1997-1998 the sub-bands 380-383 MHz paired with 390-393 MHz can be used by the Emergency Services. For the next implementation, additionally the sub-bands 383-385 MHz paired with 393-395 MHz would be provided.

Concerning further arrangements in this band, the DSI Management Team agree that the band 230-240 MHz should remain available for defence applications in time of crisis. It is further proposed that the peace time air-ground-air requirements should be re-examined once it is known in what direction civil aviation is moving in terms of introducing more spectrally efficient equipment.

Developments in digital processing are progressing at a rapid rate and thus it is believed that 25 kHz channelling may no longer be an absolute requirement for secure frequency hopping equipment. It may therefore be possible to realise an overall reduction in air-ground-air sub-bands in the future. Nevertheless the air-ground-air assignments should be transferred from the band 380-400 MHz to facilitate the introduction and development of TETRA equipment. However it is agreed that significant portions of this band should

remain available for tactical radio relays in exercise areas and that some of the defence communities administrative communications' requirements may be realised by using TETRA systems in this band. Sharing between frequency hopping systems and TETRA and T-DAB is currently being studied and early indications suggest that such sharing is expected to be feasible.

The following sub-section dealing with the band 400-470 MHz mentions the difficulty of radiolocation in this band. Concerning defence radiolocation, this may only be found in a few geographical locations, but the interference range can be considerable. There is no doubt that for some operational applications a band for radiolocation is required in the vicinity of 400 MHz. The DSI Management Team came to the conclusion that a secondary radiolocation allocation should be introduced in the band 240-380 MHz with a view to transferring requirements from 420-450 MHz to 240-380 MHz in the longer term.

Following the next re-evaluation of air-ground-air and satellite communications requirements, the DSI Management Team proposes that some of the remaining tactical radio relay spectrum should be studied for its suitability for future civil requirements, SAB might be one appropriate sharing partner, another could be active sensors operating in a new secondary allocation to the Earth exploration-satellite service. This requires further study and will depend on the final outcome concerning the proposed radiolocation band. Any Earth exploration activity should not limit the usefulness of this band for defence applications.

400-470 MHz

In the band from 400-406 MHz, it is believed that existing defence usage particularly with respect to METAIDS should gradually be transferred. However there should be some scope for introducing additional civil low power applications, particularly in the band 403-404.5 MHz.

The bands from 410-430 and 440-450 MHz have been of particular interest for defence administrative networks and some tactical applications. The bands 410-430 MHz and 450-470 MHz are also envisaged for TETRA systems and these bands should be available for civil applications in the European conurbations, with defence administration requirements being incorporated into TETRA or similar systems. In more remote areas, defence applications might predominate, but it is suggested that these should follow the channelling arrangements for this band or, if not possible, sub-bands separated by 10 MHz should be utilised. For the band 440-450 MHz, arrangements are suggested to accommodate a number of various requirements, but a similar arrangement to that envisaged for 410-430 MHz may be appropriate.

A difficult problem arises in the band 420-450 MHz concerning radio location. The DSI Management Team after considerable discussion could find no alternative other than to propose opening a secondary radiolocation band in the range 240-380 MHz taking all safeguards to avoid interference to primary users. The requirement for an Earth exploration satellite service allocation

could unfortunately not be supported in this band, but see the comments relating to the band 240-380 MHz above.

790-960 MHz

As indicated in section 9.4 above there is a need for 10 MHz of harmonised spectrum for tactical radio relay applications especially in some NATO countries. In view of the discussions currently underway to determine a new harmonised defence tactical radio relay band in the vicinity of 2 GHz, it is believed that the use of the band for defence purposes is a diminishing requirement. It is further considered that the radiolocation and radionavigation requirement should also have ceased by the year 2008.

Nevertheless it is important to note that cellular networks operating in two bands between 880 MHz and 960 MHz separated by 45 MHz are not likely to be heavily utilised in rural areas. It would therefore seem that as a minimum the GSM extension bands 880-890 MHz and 925-935 MHz could be shared on a national basis for various defence applications, particularly in the less populated areas of Europe.

It should be also noted that the band 790-862 MHz is urgently required throughout CEPT to facilitate the introduction of digital TV. After the transition period from analogue to digital TV, the position may be eased.

9.8 Recommendations

In respect of defence spectrum usage, the DSI Management Team recommend that in all CEPT countries major effort be expended on developing a spectrum management regime which is designed to provide on the basis of requirements, additional spectrum for land mobile applications in the conurbations of Europe. As a general rule, in peace time, almost all of spectrum within bands identified for two frequency mobile systems should be available, if required, for civil systems in major urban areas, such as Frankfurt, London, and Paris.

Conversely, in the bands mentioned in the previous paragraph, where there is a defence requirement, almost all of the spectrum should be available in geographical locations where harmful interference would not be caused to civil systems utilising the same spectrum in the conurbations. A different ratio of spectrum availability should apply in times of crisis and civil systems must be designed with this criteria in mind.

The DSI Management Team further recommend that negotiations should continue concerning the release of the remaining 10 MHz of the spectrum in the band 380-400 MHz for use in the conurbations, and defence authorities should as soon as possible determine their longer term air-ground-air, radio relay and radiolocation/radionavigation requirements in the band 240-380 MHz.

The DSI Management Team recommend that further sharing possibilities be actively explored, especially the accommodation of low power devices in defence bands, in particular the band 403-404.5 MHz should be available for low power devices (see also recommendation in section 10.10).

10. Other Services

10.1 Fixed Service

Present Usage

In the band 29.7 to 960 MHz the fixed radio service is used in many European countries. The main users of fixed radio services below 1 GHz are military services which still depend on ‘combat fixed radio networks’. However as discussed in section 9.4 it is considered that these transportable tactical requirements should in future be considered throughout the CEPT, as more appropriate to the mobile service. In addition public telecommunications network operators use fixed radio links in remote and rural areas as access lines to the PSTN/ISDN where wired lines cannot be provided or their provision is too expensive compared with fixed radio links. Furthermore private companies such as energy, gas and water suppliers use fixed radio links to solve their specific telecommunication needs.

CEPT Recommendation T/R 72-01

The operation of fixed radio links below 1 GHz was studied carefully for many years by CEPT and it was common understanding that these services should only be operated in frequency bands above 1 GHz and that frequency bands below 1 GHz should be freed and allocated to mobile radio services.

Consequently the CEPT developed Recommendation T/R 72-01 which states that

‘the allocation of frequencies to the fixed service in the 29.7-400 MHz band be progressively reduced until it is eliminated in the long term, except in some zones where the need does not arise‘

‘the fixed service between 400-960 MHz be progressively limited in the future to links which contain no more than 6 telephone channels or their equivalent’.

Solution

It seems that fixed radio links in general can be operated in frequency bands above 1 GHz. The aim should be to replace existing fixed links where possible by wired lines or where this is not possible to use frequency bands higher than 1 GHz.

It is therefore recommended that the allocation of frequencies to the fixed service in the 29.7-960 MHz band be progressively reduced until it is eliminated in the long term; in particular cases, as a national solution for remote and rural areas, licensing of fixed links should be permitted with secondary status only. Such fixed links should contain no more than 1 telephone channel or equivalent.

10.2 Radionavigation and Radionavigation-Satellite Services

The main requirement for the radionavigation service in the range 29.7-960 MHz is for aeronautical applications, these issues are discussed in section 10.5.3.

There are two allocations to the radionavigation-satellite service in the frequency range covered by DSI Phase II:

- 149.9-150.5 MHz
- 399.9-400.05 MHz

The only known requirement is the satellite radionavigation system called TRANSIT. This system has been in operation for many years and is just about to cease operation as it is being replaced by other systems. The spectrum involved could therefore be considered for alternative applications in the time scale envisaged for implementation of the European Table.

As a matter of principle, wideband services should, whenever possible, be transferred to frequency bands above 1000 MHz.

10.3 Radiolocation Service

10.3.1 Introduction

Radiolocation involves the determination of position, velocity, height or other characteristics of an object, or the obtaining of information relating to these parameters, by means of the propagation properties of radio waves. Wind Profiler radars although at first sight might be expected to be found in this section are believed to fall in the Meteorological Aids Service and are addressed as a key issue in section 11.14.

10.3.2 The Band 420-450 MHz

The main civil radiolocation system that operates in this frequency range is Syledis. It is currently being used in the coastal regions in Europe as well as by the North sea oil industry. The system has a rather broad bandwidth of 2 to 3 MHz. Such systems it is believed should be avoided below 1000 MHz. In particular the Syledis system should eventually be phased out, since all its functions can now be provided by the Differential GPS System.

The other usage of this frequency range for radiolocation purposes has been for ballistic missile early warning radars, mainly because of the good resolution that can be obtained, as well as the long range. This usage is limited to only a very few countries, but serves in principle the whole of Europe.

However such applications result in severe constraints on the development of civil mobile systems in this frequency range in those countries that operate such systems, which in turn puts considerable limitations on the possibility for

European harmonised bands for the mobile service. In section 9.7 it is proposed that a new radiolocation band be opened in the range 240-380 MHz to which the early warning systems might eventually be transferred.

Synthetic Aperture Radars (SAR) are used to represent the surface of the earth two dimensionally irrespective of the meteorological conditions. Unlike other systems and methods, SAR offers the benefit of high geographical resolution. SAR systems are therefore especially suitable for surveillance of the environment in cloudy and humid climates and for the supply of information about the species of vegetation, their condition as well as their moisture content. SAR can also be used for detecting vegetation, mineral resources, hazardous environments, underground water veins (down to a depth of 20 m) and small earth surface movements.

SAR equipment is available in the 450 MHz range as well as in the frequency ranges above 1000 MHz. There is also a requirement for future research in the band 80-120 MHz. The importance of SARs will probably increase in the future, since considerable interest has been shown worldwide.

It has however proved impossible to immediately identify appropriate spectrum to meet this need, it is thus suggested that further investigations be made with regard to the required bandwidth of such systems as well as the possibility of any sharing arrangements particularly on a case by case basis with defence users.

10.3.3 The Band 890-942 MHz

The utilisation of this frequency range for radiolocation is mainly for defence applications. Civil requirements for public mobile systems all over Europe and elsewhere are quite extensive, with consequential additional constraints on any future radiolocation use.

10.4 Amateur and Amateur Satellite Services

10.4.1 Introduction

The ITU Radio Regulations define the Amateur Service and the Amateur Satellite Service separately. Their objectives are, however, essentially the same and the same users are involved who use terrestrial and/or satellite means of communication according to their needs and possibilities.

In approximately 170 countries worldwide there are over three million licensed amateur stations. This number is growing at a steady rate of 7% per annum which will lead to a total of 7.5 million in the year 2008. The amateur population varies from country to country and is related to a large degree to the standard of living, political freedom, and availability of equipment. There are at the present time over one million amateurs in Japan and half a million in the USA. In the most advanced CEPT countries the average amateur population density is one amateur per 600 inhabitants.

The ITU Radio Regulations define the amateur services to be used for self-training, intercommunication and technical investigations, that is by duly authorised persons interested in radio techniques solely with a personal aim and without pecuniary interest. These services have many objectives which include, providing essential communications in the event of natural disasters, training of operators and technicians in radiocommunication and telecommunication technology at no cost to the State and community; contributing to the technical advancement of radiocommunications and the enhancement of international understanding and goodwill.

Contributions were received from the IARU and a number of national amateur organisations. In addition several administrations included text covering the amateur service.

10.4.2 Propagation Factors

Practically all propagation modes are used by amateurs in the range 27.5-960 MHz. In the lower part of the DSI range mostly ionised modes are utilised whilst in the upper part non-ionised modes are employed. Use of mixed modes is also common. The following are the most attractive:

- sporadic-E 'clouds' (noted up to 225 MHz)
- E and F2 multi-hop (up to 70 MHz)
- transequatorial spread-F (TE - so far contacts made up to 225 MHz with advanced experiments in the 430 MHz band),
- E-layer FAI (field-aligned ionisation irregularities; so far up to 225 MHz),
- aurora backscatter (all DSI Phase II bands with increasing difficulty above 225 MHz),
- meteor scatter (50-148 MHz optimum)
- earth-moon-earth (using the moon surface as a passive reflector, 144 MHz and up),
- tropospheric super-refraction and ducting (results improving with frequency),
- tropospheric scatter (50-450 MHz)

10.4.3 Spectrum Issues

Even recognising the relatively high population of amateur radio operators, many in remote areas of the world, it is still possible that propagation paths go unnoticed much of the time. In order to enhance knowledge of the way the radio spectrum can be utilised it seems that the amateur observation and beacon programme should be given every encouragement to extend and improve.

29.7-30 MHz

In view of the increasing population of radio amateurs which is expected to triple in numbers, a number of contributors requested that the band 29.7-30 MHz be reallocated to the amateur service. The DSI Management Team was not fully convinced of the need for this allocation, even on a secondary basis

and suggest that this question be re-addressed when this frequency range is reviewed in a future DSI.

30 to 50 MHz

Currently there is no allocation to the amateur service in this part of the spectrum in any of the ITU Regions. However in propagation study terms the absence of reliable continuous and identifiable signals in this range causes problems and means that the progress of a propagation event starting in the HF range and identified using beacons at 28 MHz cannot be reliably tracked as it progresses towards 50 MHz.

It has been suggested that the DSI Management Team consider the feasibility of identifying a small sub-band or individual frequencies in the vicinity of 40 MHz where beacons could be established in Europe. These could be located at appropriate geographical sites, chosen in order to minimise the possibility of interference to other radio services. The beacons would operate with an erp of around 10 dBW and would utilise fsk morse identity signals with low deviation and minimal bandwidth. The DSI Management Team are generally sympathetic to this proposal, the ISM band centred on 40.68 MHz would seem appropriate, the beacons possibly using frequencies interleaved with on-site paging. A secondary allocation to the amateur service would also seem appropriate alternatively these stations could be considered as operating in the fixed service.

50 to 54 MHz

The band 50-54 MHz is allocated in Article 8 of the Radio Regulations to the amateur service on a primary basis in Regions 2 and 3 . In addition No. 559 of the Radio Regulations allocates the band to the amateur service in a number of African countries in Region 1. For CEPT countries Recommendation T/R 02-01 provides a mechanism to allocate all or part of the band 50-52 MHz to the amateur service in accordance with No. 342 of the Radio Regulations and a large number of CEPT administrations have provided facilities for the amateur service in this band.

It is believed that these arrangements should now be confirmed with the band 50-51 MHz being allocated on a primary and exclusive basis and the band 51-52 MHz allocated on a shared primary basis with the mobile service. It is noted that the amateur service successfully shares with defence users in a number of VHF/UHF bands.

54-70 MHz

In common with the concept of propagation beacons outlined for 40 MHz, a similar allocation at 60 MHz may prove to be of scientific value. It is believed that this possibility should be re-assessed when television broadcasting is no longer operating below 68 MHz. Arrangements could be considered in the overall planning of the band 51-61 MHz for the fixed and mobile services.

70-70.5 MHz

In several CEPT countries the amateur service operates in this band on a secondary basis whilst in others it is used for sound broadcasting or mobile applications. From a propagation standpoint, 70 MHz is understood to be at

the currently known extent of F2 ionospheric propagation. Sound broadcasting in eastern Europe is likely to cease in this band within the next 15 years, and it is hoped the plan outlined in this document for the mobile services in the range 68-87.5 MHz will be acceptable to these administrations. This plan is based on a 9.8 MHz transmitter-receiver spacing. The radio astronomy requirement at 79.75 to 80.25 MHz is also recognised and the band together with its 9.8 MHz complement 69.95-70.45 MHz are considered most appropriate for single frequency mobile applications, perhaps optimum for defence users with arrangements to protect radio astronomy. It would therefore seem possible to agree to a limited amateur transmitting facility of at least 100 kHz centred on 70.2 MHz in the band 70-70.45 MHz. It is also hoped that the existing beacon network between 70 and 70.150 MHz can be maintained and extended.

144-148 MHz

As the only exclusive amateur band in the VHF and UHF range it is heavily used throughout the world for both terrestrial and satellite amateur communication. A wide variety of modes of emission are in use. Various terrestrial voice and data networks are complemented by a number of amateur satellites.

In addition to popular propagation mechanisms like tropospheric scatter or superrefraction, amateurs make use of communication by reflection from the surface of the moon, meteor trails and auroral scatter. Sporadic-E communication events appear much more frequently than was believed to be possible; amateurs have observed other propagation phenomena either previously unknown or believed to be extremely rare at these frequencies. Many amateur beacons support monitoring of propagation conditions.

In many areas the already heavy occupancy does not allow for the accommodation of any additional activity despite the rapid growth of the amateur population. Therefore, the IARU has requested the retention of the existing exclusive worldwide allocation of 144-146 MHz and suggests consideration of global harmonisation by allocating the 146-148 MHz segment to the amateur service in CEPT countries.

The DSI Management Team could not agree to this latter suggestion in view of the current and foreseen extensive use of the band 146-148 MHz by the land mobile service.

220-225 MHz
This primary shared allocation in Region 2 is actively used by amateurs providing communication opportunities complementary to that of the overcrowded 144 MHz band. Ideally access to the band in CEPT countries was considered desirable by the IARU.

This band falls within the band 216-240 MHz proposed for terrestrial digital audio broadcasting (T-DAB). The DSI Management Team agrees with the IARU that such an allocation would be generally impracticable in CEPT countries.

430-440 MHz
This band is of particular importance to the amateur service. Propagation properties at 430 MHz allow for interesting combinations of propagation modes to be used. The educational aspect of amateur radio is again fully explored e.g. amateurs predict tropospheric ducting from meteorological maps; similarly they learn astronomy to establish a position of the moon in a cloudy sky when attempting to communicate by reflection of waves from its surface and/or by means of meteor scatter. This is the only band below 1 GHz where amateurs may use conventional C3F TV and emissions of similar bandwidth.

The amateur-satellite service relies on the sub band 435-438 MHz (RR664) which presently is the only allocation between 146 MHz and 2.4 GHz allowing amateur space-to-earth emissions.

Amateurs in CEPT countries, particularly suffer from ISM interference in the 433.92 MHz ISM band. Similarly manufacturers of low power systems using this band are concerned at the interference potential of amateur emissions.

The DSI Management Team were concerned with this situation and it is hoped that the recommendation (see section 10.10.1) to open up the band 403-404.5 MHz for low power devices and establish the band 915-920 MHz as a low power and ISM band will, after an appropriate transition period, render the ISM band at 433 MHz obsolete in the very long term.

On the other hand, additional spectrum in the low UHF range is urgently required for land mobile services in the major European cities. As a consequence the DSI Management Team has determined that the band 432-438 MHz and the band 435-438 MHz be allocated to the amateur and amateur satellite services respectively on a primary basis. It is believed that amateur television activities should be transferred to bands above 1 GHz, unless modern digital processing techniques can facilitate such emissions in the available bandwidth.

It is hoped that the loss of 4 MHz, 430-432 MHz and 438-440 MHz will be balanced by the improved status of the remaining 6 MHz together with a gain of up to 2.95 MHz to the amateur service from other parts of the DSI range.

902-928 MHz
Several contributors requested consideration of a secondary amateur allocation in the range 902-928 MHz to align with the situation in ITU Region 2. If the recommendation to introduce ISM to the band 915-920 MHz is accepted it would seem feasible to allocate the band 919.5-920 MHz to the amateur service on a secondary basis.

10.4.4 Other Matters

The DSI Management Team have been asked to deliberate on two other matters, the first concerns a current problem with regard to Recommendation T/R 61-01, the CEPT amateur licence. It has been requested that amateurs which are licensed to operate in the 50 MHz band be able to use their equipment when travelling to other countries that authorise 50 MHz, under the same conditions that apply to nationals of that country.

The second is also a regulatory matter where it appears that some amateur operators are unable to participate in propagation research, because they are not authorised to listen to amateur beacons in a band in which they are not licensed to transmit.

Both issues would not seem to the DSI Management Team to be insurmountable problems and it is hoped that administrations can solve these short term difficulties within the normal work of the ERC.

10.4.5 Recommendation

The DSI Management Team recommend in the context of the European Table of Allocations and in accordance with the foregoing, that

- **the band 50-52 MHz be allocated to the amateur service on a primary basis, the band 51-52 MHz additionally to be allocated to the mobile service;**

- **frequencies in the vicinity of 40.68 MHz be considered for amateur propagation beacons;**

- **a minimum of 100 kHz in the band 70-70.45 MHz be allocated to the amateur service on a secondary basis according to national considerations, if feasible, centred on 70.2 MHz;**

- **the band 144-146 MHz be maintained with its current status;**

- **the band 430-440 MHz be reduced to 432-438 MHz with primary status for the amateur service. The band 435-438 MHz to be allocated to the amateur satellite service on a primary basis. It is additionally recommended that the 433 MHz ISM and low power band be reviewed after an appropriate time period to ascertain whether alternative arrangements for ISM and low power render its retention unnecessary;**

- **the band 919.5-920 MHz be allocated to the amateur service on a secondary basis.**

- **It is further recommended that the regulatory issues outlined in section 10.4.4 be addressed by the appropriate constituent body of the ERC.**

10.5 Aeronautical Mobile and Aeronautical Radionavigation Services

10.5.1 Introduction

In addition to the aeronautical mobile service itself, two additional service categories are defined in the ITU Radio Regulations, the aeronautical mobile route (R) service for communications along predetermined and recognised airways and the aeronautical mobile off route (OR) service generally used by military aircraft for air traffic and operational purposes.

The aeronautical (R) service is characterised by its international nature.

Radio is the primary means of ensuring the safety of international and domestic flights by means of aircrafts' communication and navigation systems. Civil aviation is heavily dependant on the standardisation of systems, procedures and the use of frequencies.

Because of the safety aspects involved with this service, the allocations to the aeronautical mobile service (R) have been made exclusive worldwide allocations in the ITU Radio Regulations.

Through criteria established by the International Civil Aviation Organization (ICAO) the body established by the Chicago Convention of 1944, the members co-ordinate the frequency assignments and their use. The signatories of the Convention observe all its obligations including those relating to the radio spectrum.

Overall co-ordination and management of the international frequency bands allocated to the aeronautical radionavigation and aeronautical mobile services is carried out by the ICAO and its regional offices through day to day co-ordination and the application of standards approved by the ICAO. The specifications relating to frequency co-ordination and equipment's minimum operational requirements are promulgated in the ICAO Standards and Recommended Practices (SARPs).

However allotment plans which are developed as parts of the Radio Regulations are developed by radio conferences organised by the ITU.

10.5.2 Administrative Procedures

Frequency management and licensing practices may differ from one country to another. In some countries frequency applications for both civil and military users are submitted to the Civil Aviation Authorities (CAA). After performing a search of the databases administered by the ICAO and identifying a frequency or frequencies for the service required, the proposed frequencies are then forwarded (in Europe) to the Regional ICAO office, the European Frequency Co-ordination Body (FCB) for co-ordination and agreement.

After agreement by the FCB, details are passed to ICAO for inclusion in databases and sent back to the applicant via the CAA.

In other administrations the radio regulatory authority is responsible for all frequency management matters and the licensing of radio services. Requirements are processed in the regulatory authority before they are forwarded to the national CAA.

When a response from the FCB is received by the CAA, the response to the applicant is passed through the regulatory authority who also issues the necessary licences.

10.5.3 Aeronautical Radionavigation Service

The aeronautical radionavigation service is a safety service and therefore requires high protection against interference. All of the comments received and reviewed by the DSI Management Team suggest that with the exception of the band 582-606 MHz, the bands allocated to the aeronautical radiolocation service should remain exclusive. The service contains all systems that provide signals to an aircraft to maintain course, headings, altitude and weather data. The international consideration of spectrum matters and the establishment of technical and operational standards is provided by the International Civil Aviation Organization (ICAO), a specialised treaty organisation of the United Nations.

The frequency ranges utilised for aeronautical radio navigation are 74.8-75.2 MHz for marker beacons, 108-117.975 MHz for VOR and the ILS localiser and 328.6-335.4 MHz for the glide path component of the ILS.

10.5.3.1 The Band 74.8-75.2 MHz (Marker Beacons)

This frequency band is being used for Marker Beacons which are a part of the Instrument Landing System (ILS).

This frequency band is heavily used in the vicinity of aerodromes all over the world, and is to be currently considered as an important worldwide requirement.

10.5.3.2 The Band 108-117.975 MHz (VOR/ILS Localiser)

This frequency range is being used for VHF Omnidirectional Radio-Range (VOR) system giving angular guidance. System characteristics and the channelling plan, which is based upon 50 kHz channelling arrangements interleaved with those of the ILS, is set by the ICAO SARPs.

Due to the international character of this system it requires international allocations, and because of the large protection distances required, many VORs have to be taken into account in planning.

Because this allocation is adjacent to broadcasting Band II, it may be subject to interference from FM broadcasting stations operating in the band 87.5-108 MHz. Further information can be found in section 7.2.2.

The DSI Management Team expects that VOR (and ILS) services will be in existence for a very long time, although some input documents suggest that VOR may cease by 2015. As a consequence the number of ILS and VOR stations are expected to increase in the future, therefore an improved use of the available band should be studied.

10.5.3.3 The Band 328.6-335.4 MHz (Glide Path)

This frequency band is currently used for the glide slope element of the ILS system. It is based on ground based transmitters and provides guidance to the aircraft in a very critical phase of the flight.

The system is used extensively in airfields all over the world and requires a high degree of protection due to critical safety considerations.

10.5.3.4 The Band 582-606 MHz

This frequency band has been utilised by the aeronautical radionavigation service for long range radars, particularly those employed on airfields. From 1 January 1995 only the United Kingdom will utilise the band 590-598 MHz for such applications. In view of the approach taken in section 7.3.9 concerning the transition to digital broadcasting it is urged that the administrations involved cease the operation of the aeronautical radionavigation service in broadcasting Band V.

10.5.3.5 Transition from ILS to MLS

ICAO has for some time considered the introduction of the Microwave Landing System (MLS), operating in the band 5000-5150 MHz. The current ICAO plan is for MLS to replace the ILS for most international services by the year 2000, which should result in an overall decrease in the use of ILS.

It should be recognised however that both ILS and MLS are methods by which an aircraft can be landed safely in periods of poor, or close to zero visibility conditions.

However, for national services, ILS is likely to continue in use and may in fact expand. Further, the extensive use of this worldwide system may require quite

a number of MLS systems to be implemented before the necessary change over from one system to another can take place.

In Europe a strategy for ILS/MLS transition is being developed, and includes the continuation of the use of ILS beyond the year 1998. ICAO will be discussing ILS/MLS and satellite radionavigation at its conference in March 1995; the question of ILS lifetime will have to be re-assessed when the results from this conference are available.

The general introduction of MLS is open to question following the development of satellite radionavigation systems such as GPS (USA) and GLONASS (Russia), both systems utilise spectrum which is outside the DSI Phase II frequency range. If there is any delay in the MLS programme, however, the result could be a general retention of the use of ILS, which may even operate in parallel with the MLS.

10.5.4 Aeronautical Mobile (R) Service

The band 117.975-136 MHz is used for air-ground-air voice communications associated with safety and regularity of flight. Both analogue voice and data transmissions are currently employed.

The band is very heavily used in the core areas of Europe, it is therefore almost impossible to accept new requirements. Because of the high flight level, 13000 metres, very large co-channel separation distances (about 500 nm) are needed. This means that emissions from stations in other countries makes some channels virtually unusable in the core area. The channel spacing is 25 kHz, however this channel spacing is currently under review by the ICAO with a view to reducing it to around 8.33 kHz.

The frequency band 136-137 MHz is currently shared between aeronautical mobile, fixed and mobile services although a consideration of the sharing arrangements is included on the agenda of WRC 97. The DSI Management Team heard of the problems of finding an appropriate European single channel assignment for air sports and believe that this 1 MHz band may provide an opportunity for satisfying this requirement.

10.5.5 Aeronautical Mobile (OR) Service

The frequency bands set aside for the OR service are normally utilised for defence purposes in individual countries. However the bands are in principle available for regional aeronautical use if and when required.

These bands are often shared with other services, and there is often an absence of co-ordination between countries with regard to operational requirements.

In Europe the main (OR) band is currently 138-144 MHz which is used in some countries for air operation control. In section 9.7 it is proposed that this band be reduced to 138-142 MHz in order to provide additional two frequency paired land mobile bands.

The DSI Management Team therefore recommend that the allocation to the aeronautical mobile (OR) service be removed from the band 142-144 MHz.

10.5.6 Aeronautical Mobile Service

The aeronautical mobile service can itself be utilised for ‘route’ and ‘off route’ applications. This is the case for the air-ground-air operations within the band 225-399.9 MHz. However, it should be mentioned that in north America, two bands, 849-851 MHz and 894-896 MHz are utilised for public correspondence with aircraft, the European equivalent TFTS system operates at 1670-1675 MHz and 1800-1805 MHz which are outside the DSI Phase II frequency range.

10.6 Civil Space Services

10.6.1 Introduction

This section deals with civil space radiocommunications services with the exception of the amateur-satellite service and the radionavigation-satellite service which have already been addressed in sections 10.4 and 10.2 respectively of this chapter. Within the DSI Phase II frequency range there are narrow primary allocations for the meteorological, space operations, space research, navigation and standard frequency and time signal satellite services. In addition, there are a number of secondary allocations to the earth exploration-satellite service and the primary mobile-satellite band at 406 MHz for emergency and safety of life applications.

There is also now an emerging interest in the development of commercial satellite systems operating below 1000 MHz usually utilising low earth orbits. Several bands are available in CEPT countries and these are addressed in the following sections.

A number of administrations have provided details on their views concerning space systems and ESA has identified a need for a band where spaceborne active sensors can be placed below 1000 MHz.

10.6.2 Scientific Space Services

In this paragraph reference has not been made to every allocation for space radiocommunication services, however where a band has specifically been mentioned in input documentation a comment has been provided.

30 MHz
It is noted that the space operations and space research band in the vicinity of 30 MHz is unlikely to be required after the year 2008.

136-137 MHz
Although it has been mentioned that this allocation is used for the reception of meteorological information from satellite it is noted that the Radio Regulations downgraded the band to secondary from January 1990 and that WRC 97 has on its preliminary agenda an item to consider the deletion of all secondary and permitted allocations in this band.

137-138 MHz
A continuing requirement for the meteorological satellite service is indicated.

400.15-401 MHz
Confirmation of interest in this band has been provided for space to space communications between astronauts and manned space vehicles.

401-403 MHz
Several contributions have identified a need to improve the status of this band in respect of the meteorological and earth exploration satellite services. This band is currently mainly used for terrestrial meteorological applications.

406-406.1 MHz
Although a mobile-satellite service band and cannot strictly be classed as a scientific application the use of this band is unique and is limited to emergency position-indicating radio beacons (EPIRBs) for the COSPAS-SARSAT worldwide network. This network is a component part of the Global Maritime Distress and Safety System (GMDSS). EPIRBs must be carried by many sea going vessels on a mandatory basis and in addition many craft are fitted with the devices on a voluntary basis. This band is protected throughout the world and this is not likely to change in the foreseeable future.

430-440 MHz
ESA has identified a requirement to place active sensors on spacecraft for research into global ecological systems achieving 4 times greater soil penetration than is possible at 1215-1300 MHz. Although any band in the vicinity of 400 MHz would be acceptable it was considered that sharing with terrestrial based radio location systems was preferable. This together with the ISM band in the vicinity of 430 MHz is discussed in more detail in this document in sections dealing with the amateur service, defence, radiolocation and low power devices. See also section 10.3.2.

460-470 MHz
It has been postulated that an allocation in this part of the spectrum will in future be beneficial for the collection of data from orbiting space craft. It seems likely that initially a secondary allocation would suffice and since the band is already allocated to the meteorological satellite service on a secondary basis, there would appear to be no problems in extending the band to the generic earth exploration-satellite service. This assumes that earth stations are located away from centres of population, which would appear compatible with existing and foreseen uses of the band.

10.6.3 Mobile Satellite Service

In addition to the COSPAS-SARSAT allocation at 406 MHz there are a number of other allocations to the land and mobile-satellite services within this DSI range. At WARC 92 several of the bands were allocated for low earth orbit (LEO) satellite systems intended for data transmission applications. These are known as 'little LEOs' when systems operating below 1000 MHz are considered.

Several of the frequency bands are currently only available in a small number of CEPT countries and although there is anticipated market demands in Europe for little LEO systems, most frequency bands suffer various constraints due to the presence of existing services.

137-138 MHz
Within this band, the sub-bands at 137-137.025 MHz and 137.175-137.825 MHz are available to the MSS in the space to earth direction with primary status (the remaining part of 137-138 MHz is on a secondary basis). The major use of the band currently appears to be the reception of data from meteorological satellites such as NOAA.

148-150.05 MHz
The MSS in an earth to space direction may utilise the band 148-149.9 MHz on a primary basis but through various regulatory provisions is constrained from seeking protection or causing interference to existing and future terrestrial and space services of most CEPT countries. The band 149.9-150.05 MHz is allocated on a secondary basis to the land mobile satellite service until 1997 when it achieves primary status. The current usage within the band 148-149.9 MHz is by mobile and fixed radio relay systems and also new mobile networks are considered in some countries. The current primary usage in the band 149.9-150.05 MHz in a number of CEPT countries is the radionavigation-satellite service.

225-400 MHz
This band is addressed in detail in section 9 since in many countries it is used for defence applications. However within this band, subject to extensive co-ordination the bands 235-322 MHz and 335.4-399.9 MHz may be generally used for the MSS whilst within these sub-bands spectrum at 312-315 MHz and 387-390 MHz is identified for LEO systems.

400.15-401 MHz
This space to earth band is again constrained by the need to protect terrestrial radio services in a number of CEPT countries.

Most countries use this band for meteorological aids and meteorological satellite applications. The band 400.15-406 MHz is a very important band for meteorological observation activities. The band is used for balloon borne radio sondes and for data transmissions via satellite from automatic observation stations. There are about 800 stations around the world that launch balloon born radio sondes 2-4 times every 24 hours.

The proposed Belgian system IRISAT (Intercontinental Retrieval of Information via Satellite) is considering this band as a downlink allocation.

Belgium is conducting a technical evaluation with NATO with respect to sharing in the band 335.4-399.9 MHz for uplink assignments.

870-960 MHz

In order to provide a complete picture the bands 806-840 MHz (earth to space) and 856-890 MHz (space to earth) are allocated to the MSS in Russia and some other European non CEPT countries. However MSS systems operate on a non-interference, non-protected basis.

10.6.4 Discussion

The various scientific space services would seem to present minimal problems in maintaining existing and responding to new requirements, provided that an acceptable long term radiolocation band can be found near 400 MHz.

A different picture emerges for the mobile satellite service below 1000 MHz. A market seems to exist for satellite based data services; the European Union's recently published mobile green paper also indicates that priority could be given to the establishment of trans European networks based on satellite based LEO systems. The green paper further indicates that common frequency bands should be designated for such systems.

There remains therefore a problem in identifying a suitable frequency band in the short term for the earth to space direction due to the presence of existing services. In the longer term, especially in the time frame envisaged for implementation of the European Table possibilities might be found for the transfer of these services. It is however difficult to gauge priorities in this regard and urgent attention must be given to developing a CEPT position on the matter.

10.6.5 Recommendations

The DSI Management Team recommend that CEPT administrations urgently address the market potential and their national requirements for 'little LEO' systems. The policy and priorities concerning 'little LEOs' and existing services should be developed in particular for the band 148-150.05 MHz but also a position for the bands 137-138 MHz and 400.15-401 MHz is required. If 'little LEO' systems are found to have sufficient priority it is further recommended that a timetable be established for transferring existing services from this band(s) or identifying alternative bands which might be more appropriate for use in CEPT countries, recognising the complications that would arise in utilising different frequency bands in Europe to those used in other regions of the world.

In the light of the current uncertainty with respect to frequencies for little LEOs in CEPT countries, the draft European frequency Table at Annex A assumes a long term need for such systems in the bands proposed by WARC-92, without the accompanying operational constraints concerning power flux densities.

10.7 Maritime Services

10.7.1 Introduction

International shipping requires international solutions to spectrum usage and to significantly alter the frequency bands allocated internationally to the maritime mobile service would have significant ramifications to the free movement of shipping in European waters. It would however be feasible to consider, if warranted, changes to the spacing between channels; this has already occurred once since 1959 with a reduction from 50 kHz to 25 kHz spacing in the VHF band.

This section examines private and public maritime usage in bands near 160 MHz and 460 MHz. Contributions have been received from a number of administrations and one maritime authority.

10.7.2 VHF Maritime

The band 156-165.2 MHz is allocated to the fixed and mobile (except aeronautical mobile) services on a primary basis. The Radio Regulations in Appendix 18 identifies the sub-bands 156-157.45 MHz and 160.6-162.05 MHz specifically for the maritime mobile service with 156.8 MHz identified for distress and safety purposes. Administrations are however able to consider the use of these bands (with the exception of 156.8 MHz) for other applications inland but away from inland waterways, however no specific provisions exist for the protection of maritime services. CEPT Recommendation T/R 25-08 indicates in its Annex 2 example, a separation of 4.6 MHz between mobile station and base station transmit frequencies in the range 156-162.5 MHz.

A review of Appendix 18 to the Radio Regulations seems likely at WRC 97.

The maritime VHF services are extremely important international services used for:

- distress and safety calling and communications,
- ship movement and navigation,
- port operations,
- intership communications,
- public correspondence.

The international maritime VHF services are also a fundamental element in the Global Maritime Distress and Safety System introduced in recent years.

The number of channels in Appendix 18 for the international maritime VHF service seems to be currently just, or almost sufficient, taking into account that an increasing number of ships are using national or regional cellular mobile systems for some part of their commercial communications. There may therefore not be a compelling need for a great number of additional channels at present. It is also recognised that it would most likely not be possible on a global basis to expand the band 156-162 MHz for international maritime applications. One contribution has however suggested the introduction of a harmonised European band for private maritime business in order to reduce equipment costs.

It is also likely that in some parts of the world, even within the European Maritime Area, there might be a need for additional channels for the maritime VHF service and some consideration has already been given to move from the existing 25 kHz channel spacing to 12.5 kHz channel spacing and proposals may be expected at a future ITU WRC to introduce 12.5 kHz spacing on a worldwide basis.

On the other hand similar or better spectrum savings might be achieved by moving directly to an appropriate modulation technique utilising for example channel spacings of 5 kHz or 6.25 kHz, if such a standard could be agreed on a worldwide basis. After an extensive transition period this could also lead to an overall reduction in the international maritime band following a revision of Appendix 18 to the Radio Regulations.

The idea of introducing a harmonised European private maritime band also seems worthy of consideration utilising 6.25 kHz or 5 kHz channels spacings. To facilitate a new generation of maritime equipment covering international and private maritime bands will require one common standard. It is further recognised that to recommend 5/6.25 kHz on a global basis will require a long transition period and compatibility between existing equipment and the next generation of equipment must be ensured. The integrity and efficient function of the international maritime service must also be maintained.

10.7.3 Recommendation

The DSI Management Team therefore recommend that CEPT administrations

- **introduce a 4.6 MHz base/mobile station transmit separation in the band 156-165.2 MHz in accordance with Annex 2 of Recommendation T/R 25-08,**

- **provide improved protection for the international maritime mobile service through appropriate measures within CEPT and relevant proposals to WRC 97,**

- **consider the designation of the bands 157.45-157.95 MHz paired with 162.05-162.55 MHz for European private maritime applications in coastal areas and along inland waterways utilising 5 or 6.25 kHz**

channel spacing, recognising that these bands should also be available for land mobile purposes where such use does not affect the maritime service,

- **in preparation for WRC-97 and a review of Appendix 18 and in order to provide a market for reduced channel spacing maritime equipment, develop proposals to introduce 5 or 6.25 kHz channel spacing on a global basis for all new maritime installations as soon as possible, recognising that a full changeover will not be feasible for many years,**

- **It is further recommended that the sub-band 160.975 to 161.475 MHz be examined for its suitability for general single frequency applications e.g. wide area paging, low power devices or services ancillary to broadcasting.**

10.7.4 UHF Maritime Channels

The frequencies 457.525 MHz, 457.550 MHz, 457.57 MHz, 467.525 MHz, 467.550 MHz and 467.575 MHz are generally designated internationally for on board communications. Since these can be seen as 3 dual frequency channels in the plan indicated in Recommendation T/R 25-08 there would seem to be minimal problems for CEPT countries.

The DSI received no proposals for amending or increasing the amount of spectrum provided for this application.

10.8 Radio Astronomy Service

There are a number of allocations for the radio astronomy service throughout the DSI Phase II frequency range. The following sub-sections review the situation in the various bands.

10.8.1 37.5-38.25 MHz

This allocation was modified only slightly by WARC 79. On a worldwide basis the radio astronomy service has a secondary allocation shared with the fixed and mobile services. In the United States the band 38.00-38.25 MHz is shared on a primary basis with the fixed and mobile services. Despite the secondary allocation, this band is often free of interference and is quite useful for radio astronomy.

10.8.2 73.0-82.5 MHz

Within the frequency range 73-82.5 MHz regional allocations to the radio astronomy service are utilised for monitoring the interplanetary ‘weather’ structure in the solar wind by an international network of instruments.

The band 73-74.6 MHz, with the exception of several central American countries, is a primary and exclusive band in ITU Region 2 for the radio astronomy service. Prior to WARC 1979 the band had a similar status in ITU Region 3. No. 568 of the Radio Regulations applies to all three ITU Regions and requests administrations to take all practicable steps to protect the radio astronomy service in this band, although there is no allocation to this service in the Table, or by footnote, in Regions 1 and 3.

In ITU Region 3, with the exception of some Asian countries including India and Japan, the band 79.75-80.25 MHz is additionally allocated to the radio astronomy service on a primary basis, the band already being allocated to the fixed and mobile services.

In the United Kingdom the band 80.5-82.5 MHz is used in lieu of the bands mentioned above.

The DSI Management Team have been told that a worldwide primary and exclusive radio astronomy allocation is highly desirable. It does seem however that the world at large is already split between two candidate bands, with currently no explicit allocation in Region 1. Within Europe, the Region 3 allocation seems preferable to the one utilised in Region 2, an appropriate entry has therefore been included in the draft European Table at Annex A for an equal primary allocation with the land and maritime mobile services in the band 79.75-80.25 MHz. A secondary allocation to the radio astronomy service has been included for the band 73-74.6 MHz.

10.8.3 150.05-153.0 MHz

This is a shared, primary allocation in Region 1. It falls near the middle of a wide gap in continuum coverage. In the United States as well as in Europe, a large amount of interference occurs in this band. A continuum band is badly needed between the current 74 and 327 MHz allocations. This band is widely used in the United Kingdom and is a major band for the Giant Metre-wave Radio Telescope, GMRT, in India. Further worldwide consolidation would be most desirable.

This band is also used for pulsar observations and solar observations.

10.8.4 322-328.6 MHz

This band is increasingly being used in all regions, because major telescopes are operating or planned on these frequencies to study the structure of radio galaxies. There will be strong pressure, internationally, for increased protection of this band, including especially the avoidance of transmissions from satellites and aircraft.

This band has the desired octave-spacing relation with the 150.05-153 MHz and 608-614 MHz bands, which is needed for continuum observations and in

addition it contains an important atomic spectral line: the hyperfine-structure spectral line of deuterium at 327.4 MHz. The relative abundance of deuterium to hydrogen is related to the problems of the origin of the universe and the synthesis of the elements. A determination of the deuterium abundance in the universe will certainly help in defining the most probable theory of the origin and evolution of the universe. Recent ultra-violet observations of deuterium show that its abundance is not uniform, suggesting that studies of its abundance may be of increasing importance.

This band is also used for pulsar observations. In many countries this band is used for daily solar observations and for co-ordinated observations with the VLA (USA).

In Europe the frequency band 322-328.6 MHz is used by the Westerbork Synthesis Radio Telescope in the Netherlands and for VLBI applications by radio observatories in France, Germany, Italy, the Netherlands, Poland and the United Kingdom. As detector technology advances, activity in the band is increasing.

10.8.5 406.1- 410 MHz

This is an important band for radio astronomy, but its usefulness is decreased by interference from balloon-borne transmitters which nominally operate in the band 400.15-406 MHz. It would be desirable to reduce the interference potential by lowering the upper limit of this meteorological aids band or by extending the radio astronomy band upwards by a few MHz so that emissions near the lower end of the band could be avoided.
This band is the ‘workhorse band’ for low frequency observations of pulsars. These include pulsar surveys, which are typically several months in duration, and regular pulsar timing observations.

10.8.6 608-614 MHz

Various radio astronomy allocations having various degrees of protection co-exist with national television use in this frequency range. Numbers 687, 688, 689 and 690 of the Radio Regulations provide for radio astronomy in the band 608-614 MHz. Radio astronomy attaches considerable importance to the maintenance of this allocation since, without it, there would be a large gap between the 410 and the 1400 MHz allocations, in one of the most interesting parts of the spectrum. The band is of special importance for (worldwide) VLBI observations. It is requested that in those parts of the world in which the allocation to radio astronomy is on a temporary basis, greater security can be afforded and radio astronomy given the maximum possible protection from both in-band and adjacent transmissions. Primary allocations with several MHz common to all regions are ideally desired.

10.9 Meteorological Aids Service

10.9.1 Introduction

This section deals with terrestrial meteorological applications, satellite based systems having been covered in section 10.6. Only a few bands are allocated to the Meteorological Aids Service in the Radio Regulations and they are addressed in the following paragraphs. Those organisations and administrations expressing views on this service have indicated that all allocations should be maintained due to possible increased requirements in the future. The question of wind profiler radars is considered a key issue and is therefore addressed in section 11.14.

10.9.2 Frequency Bands

In this section consideration is given to the various bands allocated to terrestrial met' aids.

153-154 MHz
Secondary allocation not available in all countries.

400.15-406 MHz
Primary allocation, between the lower band extremity and 403 MHz the band is shared with space radiocommunication services, the band 401-406 MHz is additionally allocated to the fixed and mobile services on a secondary basis.

10.9.3 Discussion

Met' aids in the band 400.15-406 MHz are mainly weather sondes launched on balloons or other flying object to relay information from the upper atmosphere to weather stations located at appropriate points on the earth's surface. Around 1.3 million equipment are produced globally every year. Technical requirements differ in Europe from one country to another, e.g. one country requires that the drift of the transmission can be $\pm$ 5 kHz whilst some others allow a maximum drift of $\pm$ 300 kHz.

With the equipment operating in the band 400.15-406 MHz, the location of the sonde is determined using a radionavigation receiver on-board the balloon. Omega, Alpha and Loran-C radionavigation systems are used for this purpose. Because these radionavigation systems are foreseen to be phased out within the next ten years, the trend is to utilise the GPS on the weather sondes. Having a Loran-C/Omega/Alpha or GPS receiver 'on-board' makes the sondes in the 400 MHz band more expensive than the systems operated in 1700 MHz area, where the information providing the location of the sonde is based by a theodolite measurement. Radiotheodolite systems are preferred by defence related weather sonde users because of their independence from radio navigation systems. Technically radiotheodolite systems are not feasible in the 400 MHz range because of the large size of antennas. Basically the information received from both systems (400 and 1700 MHz) is of the same accuracy.

Rearrangement of the bands above 410 MHz have necessitated finding a solution for low power devices using powers not exceeding 10 mW erp, on a CEPT wide basis. It is believed that the band 403-404.5 MHz should be a candidate for this application and an entry has been included in the European Table accordingly. If this band is occasionally still required for sondes, it is believed that in most cases interference should not occur.

The DSI Management Team recommend that weather sonde systems operating in the 400.15-406 MHz band should be moved gradually to the 1.7 GHz band.

10.10 Other Applications

10.10.1 Low Power Devices

In the past CEPT policy on various low power applications has been based on 'system' specific recommendations with little co-ordination concerning specific frequencies of operation resulting in concern and confusion within the industry. Telemetry and telecommand equipment operating in ISM or non-ISM bands which operate on a non-interference, non-protected basis therefore have their own CEPT recommendations. Despite these recommendations very few frequencies have been harmonised on a European basis

ETSI has recently developed three generic standards for short range low power devices:

I-ETS 300 220 covers the frequencies between 25 and 1000 MHz
I-ETS 300 330 covers the frequencies between 9 kHz and 25/30 MHz
I-ETS 300 440 covers the frequencies between 1000 MHz and 25 GHz

These standards are based on existing CEPT Recommendations and national performance standards. Only I-ETS 300 220 is applicable to the DSI Phase II frequency range.

ETSI has introduced the category Short Range Device which covers a vast number of different applications. Most applications are either telemetry or telecommand, although some applications require speech, for example a baby monitor. Other systems covered are tagging devices where an interrogating signal is sent and the tag responds. Devices are not necessarily restricted to one radio service and can be used in fixed locations, whilst mobile or even for marine applications. An example of this is remote meter reading where the meter unit can either be alerted by a mobile unit or a signal from the control unit, the meter then sends data from the fixed meter to a fixed point or mobile.

Contributions from industry indicated the need for harmonised bands to compliment European technical standards. Up to now there has not been a sufficient number of harmonised frequencies available to meet the different requirements at the European level.

35 MHz Area

Currently equipment for the control of model aircraft on a protected basis operates in this range. This is not a harmonised band throughout Europe.

40.66-40.70 MHz

This band is an ISM band and is used for various applications. It is recommended in CEPT Recommendation T/R 20-03 for the use of telemetry and telecommand equipment and in T/R 01-04 for low power devices.

48.5-50 MHz

This band is currently recommended for use by low power applications and on-site paging systems in Recommendation T/R 02-01. Due to television broadcasting in this band it has so far not been widely used for these applications.

433.05-434.79 MHz

The ISM band centred on 433 MHz is widely used in Europe for several low power applications e.g. car door openers.

Some contributions mentioned the current difficulties in sharing, since the band is also used by high power amateur radio equipment. Another current problem is that some countries allow the use of low power applications in the whole ISM band while in other countries only a part of the band is used. This creates confusion within industry and also makes the free circulation of equipment according to the current recommendations rather difficult.

900 MHz Area

Recommendation T/R 75-02 recommends the band 868-870 MHz be used for telemetry and telecommand applications. In addition the same Recommendation recommends the band 888-890 MHz be used, in addition to DSRR, for telemetry and telecommand applications. These bands are not widely used for such low power applications because of heavy existing usage (lower band, e.g. defence) or expected heavy usage (higher band, DSRR). In ITU Region 2 there is an ISM band at 902-928 MHz (centre frequency 915 MHz). For ISM bands see also section 10.11.

Some contributions requested protected channels for social applications, e.g. alarm systems for elderly people. One 12.5 kHz channel should be identified for this purpose in the band 138-142 MHz.

Attention was also drawn to the fact that while many systems are intended for infrequent transmission allowing for easy and efficient frequency sharing, some other systems are designed to transmit continuously thus making

sharing impossible. A solution is proposed by grouping these different types of operations into separate frequency sub-bands, e.g. 5 sub-bands of 200 kHz per MHz, including 3 sub-bands for data (intermittent transmission), 1 sub-band for speech (continuous transmission) and 1 sub-band for low image rate video (continuous transmission).

The DSI Management Team endorsed such proposals in principle and agreed that their implementation should be studied with regard to the additional frequency bands proposed below for low power devices.

The DSI Management Team recommend that:

- **the different terms used in CEPT Recommendations and ETSI Standards for low power applications be harmonised.**

- **protected channels for the control of model aircraft within the band 34.995-35.225 MHz be agreed.**

- **a general low power application band at 138.00-142.00 MHz be agreed.**

- **an allocation be agreed for a general low power band at 403-404.5 MHz intended for new applications and to avoid placing new equipment at 433 MHz unless absolutely essential, the 433 MHz band to be subject to a general review at an appropriate time.**

- **a general low power application band at 915-919.5 MHz be allocated.**

10.10.2 Cordless Telephones

There are currently several technical standards and frequency bands used in Europe for cordless telephones. The early generation cordless telephones usually operate in the range 46-50 MHz, though there is also equipment operating at 1.6-1.8 MHz, 26 MHz and in the 31/39 MHz range. There is no European technical standard or harmonised band for these early generation systems.

The first European system called CT-1 was introduced in the early 1980s. This system, now implemented in around 20 CEPT countries utilises the frequency bands 914-915 MHz paired with 959-960 MHz and comprises 40 analogue duplex channels in accordance with CEPT Recommendation T/R 75-02. These two bands currently overlap with the core GSM band (890-915 paired with 935-960 MHz). There is an ETSI standard I-ETS 300 235 detailing the system specification

An extended version, called CT-1+ has been implemented in 4 central European countries. CT-1+ uses the frequency bands 885-887 MHz paired with 930-932 MHz giving 80 analogue duplex channels. There have been clear indications that CT-1 and CT-1+ systems are not intended to remain operational by the year 2008.

The digital CT-2 system operates in the band 864-868 MHz, which in the current CEPT Recommendation T/R 75-02 is recommended to be used for single frequency land mobile systems. Besides the conventional CT operation i.e. base station communicating with hand set, a more advanced facility known as telepoint has been incorporated within this system. The telepoint concept allows the hand set to call via a public base station to the PSTN/ISDN. On some systems this facility has also been introduced in the return path to facilitate the receipt of calls from the PSTN/ISDN. Currently CT-2 has been introduced as a conventional cordless telephone application in several European countries, but in Europe the telepoint feature is currently only available in two countries, the Netherlands and France. Several countries have conducted trials or introduced operational telepoint systems, but after a period of time decided against the system.

One contribution from a network operator indicated that additional frequencies should be reserved for CT-2 wireless local loop (WLL) applications. WLL is discussed in section 8.5.

Outside the DSI Phase II frequency range, but worth mentioning here is the Digital European Cordless Telecommunication system, DECT. ETSI has produced a technical standard for this concept of cordless communication, including both the conventional cordless telephone and telepoint application.
The frequencies for DECT (1880-1900 MHz) are defined in the CEPT ERC Decision, CEPT/ERC/ DEC(94)/03.

The DSI Management Team therefore recommend that cordless telephone/telecommunications systems should use frequencies above the DSI Phase II frequency range by the year 2008, preferably utilising the DECT system operating in the frequency band 1880-1900 MHz.

10.10.3 Cordless Microphones

According to the number of input documents to DSI Phase II, it seems that there is an urgent need to harmonise frequencies used for cordless microphones in Europe. The current CEPT Recommendation T/R 20-06 recommends that the band between 26.1 and 47 MHz be used for these applications. ETSI has been producing a technical standard to be published during 1995. This standard will cover equipment operating in the band 25-3000 MHz.

In addition to the band mentioned in Recommendation T/R 20-06 there are several sub-bands available within the current broadcasting Bands III, IV and V which can be used for cordless microphones. Their use is however subject to a number of restrictions, for example to be used only inside buildings or on a non-protected, non-interference basis with broadcasting. These bands are implemented nationally and no European harmonisation exists.

The proposals for harmonisation coming from users stressed that a significant number of theatrical and musical productions are roaming across Europe, thus frequencies need to be available on a pan European basis. A good example is the 1994 Pink Floyd concert tour in Europe. Around 40

channels were used within the VHF/UHF broadcasting bands and each country the group visited had to evaluate the possibilities for authorising this equipment within their territory. (See Annex J)

From the administrative point of view the biggest argument for harmonisation is the growing number of unlicensed and unapproved low quality products in use. The ETSI wireless microphone survey in 1992 estimated the number of equipment in legal use to be around 300 000, but that equipment working outside the existing regulations was estimated to be 10 times greater than this number.

With the existing analogue equipment 12 intermodulation free channels could be accommodated within one 8 MHz TV channel. To fulfil the requirements of a big production (40 cordless microphone channels) the spectrum from more than three TV channels would be needed; the blocks should in addition be separated by several MHz to avoid intermodulation problems.
In the US the FCC has allowed the operation of cordless microphones in the 2400-2483.5 MHz band using CDMA techniques. DSI Phase I recommended that the band 3430-3480 MHz be used for low power devices including cordless microphones and short range data applications.

It is recommended that three bands should be made available for cordless microphones 29.70-34.90 MHz, 174.00-175.50 MHz and 862-875 MHz. The band 174.00-175.50 could already be available in some countries but may only become generally available following the transition from analogue to digital TV broadcasting

Digital systems are expected to utilise frequencies above this DSI range in the future. Further work is needed to study the availability of the 2.5 GHz range for this equipment in Europe.

10.11 ISM

10.11.1 Introduction

Industry, Scientific and Medical use of the radio spectrum is not defined as a radio service in the Radio Regulations. Since strictly speaking the use of radio frequency energy for heating, lighting, cooking, scientific experiment etc. is not passing information, ISM in most CEPT countries is therefore not subject to licensing. In addition other radiocommunication services using frequencies identified for ISM cannot claim any protection from interference they may experience from ISM apparatus. There has also been a tendency in recent years to use ISM bands also for deregulated low power radiocommunication applications in view of the uncontrolled ISM situation.

10.11.2 Current Frequency Band Situation

Within CEPT countries in this DSI Phase II range there are two bands officially identified as ISM bands, 40.68 MHz (± 20 kHz) and 433.92 MHz (± 870 kHz).

In ITU Regions 2 and 3, the Americas, Far East and Pacific areas the band 902-928 MHz centred on 915 MHz is also designated as an ISM band. This has led to difficulties in Europe when ISM and low power equipment has been imported and operated in contravention of national frequency tables or accommodated on a case by case basis.

One CEPT country, the United Kingdom attempted to overcome this difficulty by introducing a national ISM allocation at 886-906 MHz. Shortly after the commencement of co-channel analogue public cellular mobile systems, some interference was caused to base station receivers. However the UK control monitoring service report minimal problems since the mid 1980s. This is probably because pure ISM applications in the 900 MHz band are limited to food processing (industrial), RF plasma generators and rubber vulcanisation equipment. RF powers are generally less than 200 kW and currently less than 2000 equipment are in operation worldwide. (Source ITU-R Study Group 1 documentation.) However, the introduction of cellular necessitated the transfer of some low power devices to other parts of the 900 MHz band as co-channel operation proved difficult.

10.11.3 Future Arrangements

The DSI Management Team whilst receiving no direct input on the ISM situation has heard that the use of 433 MHz is of concern to the amateur service and the presence of numerous high power amateur emissions is of concern to manufacturers of low power devices.

In view of the deregulated and uncontrolled nature of ISM and low power devices this situation can only be rectified on a very long term basis by allowing existing equipment to phase out naturally.

The DSI Management Team has developed an overall strategy for the situation which is the subject of various recommendations (see sections 10.9.3, 10.4.5 and 10.10.1). Firstly no change is envisaged at 40.68 MHz. A new low power band is proposed at 403-404.5 MHz and a new ISM and low power band is proposed at 915-920 MHz coincident with part of the Region 2 ISM band.

In the very long term the 433 MHz situation might be reviewed in the light of new arrangements at 403 and 915 MHz and if feasible the 433 MHz ISM and low power band might be phased out after full consultation with industry and users as existing equipment becomes unserviceable. In the case of low power equipment this might be achieved by the withdrawal of type approval or type acceptance for the equipment in question.

The DSI Management Team recommend that administrations should take all practicable steps to minimise the radiation from ISM equipment and should ensure that any out of band radiation does not cause harmful interference to any radiocommunication service operating in adjacent bands.

11. Key Issues

In preparation for DSI Phase II several key issues were identified as a means of stimulating input to the Investigation. A number of contributors addressed these particular issues in detail. This chapter therefore considers each item in turn and provides an explanation on how the matter has been handled within the DSI process. For some key issues this chapter is the only place in this Results document where the matter is considered, therefore the reader will find a number of recommendations included in the texts. Sections 11.1 to 11.14 deal with key issues identified in the DSI Phase II information document; the remaining sections deal with additional issues which the DSI Management Team feel are of sufficient importance to highlight in this chapter of the Results document.

11.1 Band 790 to 862 MHz

Although falling within the definition of broadcasting Band V this allocation has in a number of countries been allocated primarily to the fixed and mobile services and in another group of countries to the aeronautical radionavigation and radiolocation services. Prior to the DSI it was felt that the band 790-862 MHz might provide opportunities for civil land mobile radio applications or broadcasting.

In chapter 7 it is recommended that as soon as possible and until the year 2020 the entire band from 470-862 MHz (but see section 10.8 concerning the band 608-614 MHz) should be available for terrestrial television broadcasting in order to facilitate the introduction of spectrum saving digital modulation techniques. CEPT countries that have so far not released the band 790-862 MHz to the broadcasting service are therefore encouraged to do so, on the understanding that this additional spectrum should not be used to extend existing analogue television networks.

If any spectrum savings can be made in the long term in the band 470-862 MHz it is envisaged that they will come from the lower end of the band rather than from above 790 MHz. It is therefore unlikely that the band 790-862 MHz can be considered for mobile services other than for services ancillary to broadcasting.

11.2 Band 225 to 400 MHz

This key issue concerns the possibility of increased sharing between civil and defence radio systems in this frequency range. Chapter 9 looks at overall defence matters whilst sections 9.4 and 9.7 address *inter alia* the requirements and the DSI Management Team's proposals for this band. It is envisaged that the future specific peace time band for defence (particularly within the European conurbations) should be reduced to 240-380 MHz to cater for DAB and TETRA developments. Further sharing may be possible if technological advances in signal processing can be converted into spectrum gains for future generations of secure air-ground-air equipment. Additional civil use of radio relay bands may be feasible on a pre-emptible basis in certain geographical areas, however the increased use of the band for

radiolocation activities may render additional sharing extremely difficult. The above comments particularly apply to CEPT countries that are also members of the NATO alliance. In those countries where there is a reduced requirement for air-ground-air applications it may be appropriate to provide more access to the band 240-380 MHz for civil applications. However co-ordination is encouraged in order that air-ground-air planning is not made unduly difficult in the more congested parts of Europe.

11.3 Developments in Cellular Radio

The question asked for this item concerned how long existing analogue public mobile networks might operate in the presence of current and future digital systems. However this simple question raises a number of competitive and regulatory questions which some administrations are already addressing (see also chapter 8).

Public mobile radio schemes have expanded rapidly in recent years and early national VHF systems have generally been replaced either by 450 MHz national and regional schemes such as NMT-450, or in those countries which had a large unsatisfied mobile requirement in the early and mid 1980s, 900 MHz cellular analogue systems such as NMT-900 and TACS (a derivative of US AMPS technology) were implemented .

It is important to remember that the NMT standard does not readily permit two competitive systems to function in the same geographical area, whereas the TACS standard can easily accommodate a competitive environment. Thus NMT-900 operators are generally operating with a large customer base within a monopoly analogue environment. Some TACS networks on the other hand have operated in a competitive situation from the start of service.

This situation is particularly important when the next step to digital GSM networks is considered since many of the monopoly analogue operators are in a competitive situation with new GSM operators and at the same time are building their own GSM networks.

Some TACS operators are also facing a different yet similar situation with a still expanding analogue customer base and a new GSM network to build, maintain and earn revenue.

Already the situation is becoming more complicated with the possibility of some GSM operators additionally building a DCS1800 (GSM operating at 2 GHz) network and infrastructure to enhance their service in city areas, or in another scenario are facing another layer of competition from new DCS1800 operators. Many cellular operators are also already studying the next generation of network technology due to commence implementation early in the next century, the so-called third generation FPLMTS or UMTS systems.

Where does all this leave the operator? It is clear that operators will wish to gain maximum profit from existing networks and will seek to transfer customers to their new networks as old equipment becomes too expensive to maintain. However new GSM and DCS1800 operators entering the business for the first time will be concerned at the market dominance of operators having existing analogue networks especially if these are operating in a monopoly environment. Regulators will also wish to ensure, within limits, the

profitability of new mobile networks which have been introduced to provide market stimulation and freedom of choice for the consumer.

In spectrum terms the DSI Management Team are concerned at the amount of spectrum at 450 MHz, 900 MHz, 1800 MHz and 2000 MHz which could be employed for public mobile systems in the relatively near future, unless steps are taken to phase out obsolete technology at the turn of the century.

The DSI Management Team therefore recommend that analogue public mobile networks should be closed not later than 2008.

Any spectrum recovered at 450 MHz should be considered for expansion of future European harmonised mobile systems.

11.4 Professional Mobile Radio (PMR) and the influence of Service Provided Trunked Systems

Section 8.2 addresses the non-public land mobile radio scene in detail and it is clear that the differing situation in the various CEPT countries makes prediction extremely difficult. It seems that service provided trunked mobile radio or common base station systems will satisfy a part of the PMR market and together with public cellular systems will continue to take market share from the conventional self-provided PMR system.

On the other hand for certain categories of users such as small rural systems with large coverage areas and some large regional schemes with many mobiles, the demand for self-provided owner operated (sometimes sophisticated) PMR systems will continue to rise.

The DSI has opted for a dual approach to this matter identifying appropriate spectrum for TETRA systems in the short and medium term whilst encouraging the overall harmonisation of mobile radio bands throughout Europe, which will facilitate the availability of spectrum and extension of conventional PMR networks.

Medium and longer term solutions for considering additional harmonised bands for mobile radio will allow a future generation of regulators to determine whether additional spectrum should be released for PMR in the light of other priorities and commercial demand.

11.5 Future Technology

This key issue focused on the possible impact of modulation and access techniques and whether there would be any likely consequences for spectrum planning in the range covered by this phase of the DSI.

Comments on this key issue generally concentrated on the points raised in the DSI information document with a general acceptance that CDMA, linear modulation and digital broadcasting techniques are likely to be introduced in the future. Again future improvements in digital compression are likely to influence CODEC developments in systems such as TETRA and GSM and may lead to reductions in necessary bandwidth.

A related issue, where some misgivings have been expressed, concerns how new technology proposals should be introduced in the European environment. The following points would appear pertinent:

- if ETSI or CENELEC come to a democratic decision on a technology development should that decision be challenged ?
- should CEPT's view on spectral efficiency concerning a specific technology be the deciding factor in a competing technology scenario ?
- if two or more competing technologies are generally acceptable from all perspectives, how important is the goal of harmonised frequency usage in Europe, especially in border areas ?

On these matters the DSI Management Team recommend that ETSI decisions should not be re-opened without extremely good reason. In order to make the best use of industrial and standards organisations' resources it is additionally recommended that advocates of new technologies should in parallel with national considerations input ideas into the European fora to gauge their acceptability. Ideas that have been formally considered and rejected in ETSI should not be resurrected in ETSI unless there are obvious changes in the telecommunications environment which would indicate a change in policy is justified.

It is noted that the most difficult problems seem to arise when administrations seek to propose an already developed national standard to be extended into Europe. If rejected it is difficult for the administration nationally, if accepted it could be difficult for manufacturers and administrations that have invested financially and spectrally in an alternative technology.

An additional area of concern that could merit some attention on a European basis is the potential for adjacent band interference due to the introduction of new technology. Spread spectrum techniques, especially direct sequence systems, produce a wide series of side bands whose amplitude fall slowly with frequency. Due to the lack of practical experience this problem to date has been difficult to evaluate, however such considerations underline the need to assess the impact of introducing new technology in terms of compatibility with existing services.

11.6 Digitalisation in Broadcasting

Sections 7.2 and 7.3 deal with sound and television broadcasting respectively and this particular key issue addresses what impact the digitalisation of broadcasting will have.

It seems that this question has to be considered on a short and long term basis. In the short term there is no escaping the fact that programmes will have to be broadcast simultaneously in the old analogue technology and in the new digital format for very many years. This means that broadcasting bands must be used more intensively and in some cases additional spectrum will be required. The knock-on effect concerning alternative spectrum for services ancillary to broadcasting (SAB) must also not be forgotten since 'holes' in the broadcasting bands have traditionally been used for SAB. With the intensity of use expected in the future these holes will disappear.

In the longer term, after analogue services have generally closed it is expected that digital broadcasting may bring spectrum savings. It will be for regulators in the future to determine whether such spectrum should be used for extending choice in broadcasting or to meet the expansion aspirations of other radio services.

11.7 The Impact of Cable and Satellite Broadcasting

It is perceived that cable and satellite may have an impact on the provision of future broadcasting in two significant ways. Firstly, it is believed that the information highway and true multi-media services will take place in the foreseeable future.

In this development terrestrial broadcasting networks will play an essential role in supplying large amounts of information at the same time to many locations (point to multipoint) in an economical way; for portable and mobile reception it may be the only practical way. This information could either be used in real time (conventional broadcasting) or downloaded, stored and distributed via a selection process to be used later. It should be noted that the digital systems which are currently under development for terrestrial television are suitable for interworking with other networks and services.

It is generally believed that the return path requires less capacity and could be provided by telephone cable or mobile radio equipment. For applications requiring more capacity, future mobile terminals will provide the interactive element

A second less futuristic scenario, recognises the current situation where more and more European public service broadcasters (France, Germany and Italy are notable examples) are duplicating their national terrestrial service on satellite networks capable of direct to home reception. For large coverage areas this is seen as a cost effective mechanism to achieve efficient and reliable service. Terrestrial broadcasting may therefore in the future be seen mainly as a mechanism for providing local or sub-regional services.

The DSI Management Team make no additional recommendations on this subject but would reinforce the need to review the amount of spectrum required for terrestrial broadcasting during the transition from analogue to digital broadcasting, together with an assessment of the impact of satellite and multimedia interactive programming.

11.8 Technology change-over period for Broadcasting

The changeover from analogue to digital television broadcasting may offer enormous potential for additional broadcasting programming or the introduction of alternative services in spectrum currently allocated to the broadcasting service. Chapter 9 fully describes the DSI Management Team's views on the transition period considered necessary to broadcast simultaneously in old and new technology formats. A period of 24 years and 22 years has been identified as appropriate for sound and television respectively, before spectrum could be considered for alternative applications. This period is based on previous experience in countries where major changes concerning broadcasting standards have been introduced in the past and where it is necessary to replace hundreds of millions of receivers.

Input documentation to DSI Phase II has suggested that a simulcasting period of between 10 and 25 years is required. If in the light of the envisaged programming, current political thinking and the pace of technical change a period approaching a date in the lower quartile, rather than the upper quartile of the range could be anticipated, then the goal of meeting all spectrum requirements placed before the DSI Management Team might be easier to realise. This issue was raised several times during the DSI Seminar with little or no comment, it is therefore hoped that following the publication of this Results document the public consultation process will provide additional comment and feedback.

11.9 Sharing between Broadcasting and Other Services

In order to satisfy the requirement for additional mobile radio spectrum below 500 MHz the question of possible sharing between television and mobile radio was raised.

There are some notable examples, the UK situation where broadcasting Band III mobile services share with broadcasting in neighbouring countries, the French example where land mobile and broadcasting in Band III share within the country, as well as with neighbouring countries and the North American approach where some UHF television channels are shared on a geographical basis.

If the hypothesis is accepted that terrestrial television will move more and more towards serving local and sub-regional areas, future broadcasting requirements will be almost identical with those of mobile radio e.g. the maximum requirement will occur in the major conurbations. Therefore sharing a broadcasting band with civil land mobile radio in city areas may not gain maximum use of the available spectrum.

This matter should also be reviewed once the transition to digital transmission has commenced.

11.10 Additional Pan European Radio Systems

This question was intended to identify any future major pan European spectrum requirements, recognising that Europe has already developed solutions for cellular (GSM), cordless (DECT), paging (ERMES), terrestrial

digital sound broadcasting (EUREKA 147 T-DAB), aeronautical public correspondence (TFTS), professional mobile radio (TETRA), digital short range radio (DSRR) and road traffic telematics (RTT). Standards are also being developed for high performance local area networks (HIPERLAN) and digital terrestrial television. Future mobile systems are being addressed in the various UMTS/FPLMTS fora.

Several administrations have mentioned the need to find an appropriate solution for railway communications required by the International Railway Union (UIC). Spectrum at 900 MHz has for some time been identified for this application, however an operational requirement is that the UIC system should be able to function in the vicinity of GSM systems which may be in close physical proximity of UIC equipment.

It is hoped that the solution proposed for the 900 MHz band in Annex A will enable a UIC system to be introduced by 2008.

The other pan European requirement mentioned by several operators and industry is the need for harmonised frequency bands to provide for 'wireless local loop' (WLL) applications. Section 8.5 covers this requirement in some detail.

11.11 Harmonisation of Low Power Devices (LPDs)

Nearly all contributions mentioning LPDs commented in positive terms on the need to develop a harmonised environment for these devices. A particularly pertinent comment came from one administration which had deregulated a number of bands for LPDs regarding the difficulty of moving devices in the short term which are operating in a deregulated situation (see also section 3.7).

On a number of occasions CEPT has sought to harmonise LPD bands more precisely, but such initiatives have always had to be abandoned because of the multitude of national solutions already in place. ERO members of the Management Team also indicated that a significant number of enquiries were received concerning the various national situations for LPDs and the difficulties this situation presented for equipment designers and importers of equipment from outside Europe. It is also noted that in any event many imported devices (particularly toys) operate reasonably successfully in Europe, but illegally in bands authorised in some non-European countries.

The DSI Management Team has taken this issue particularly seriously and has attempted to formulate long term European proposals for several categories of LPD, for example, model control, wireless microphones, on site paging and associated talk back facilities. The Management Team would also wish to underline their suggestions for general LPD bands at 49.5-50 MHz, 138-142 MHz, 403-404.5 MHz and 915-920 MHz. With the exception of 403-404.5 MHz and 138-142 MHz these bands are also used for LPDs in other parts of the world and the DSI proposals, if accepted, should facilitate international harmonisation. The possibility of extending the 138 MHz and 403 MHz LPD bands to the Americas should be encouraged through discussions with CITEL and individual member administrations.

The DSI Management Team would additionally recommend that any national solutions being considered for LPDs be fully debated within CEPT before any definitive decision is reached. Such a policy it is believed would benefit the overall European harmonisation project.

11.12 Pricing Mechanisms in Spectrum Management

The DSI Information Document asked for comments on the trend, developing in several countries, to introduce pricing mechanisms into the established spectrum management and licensing regimes. It was determined by the DSI Management Team that this issue should be addressed at length, the reader should therefore refer to chapter 12 for information on this matter and associated recommendations.

11.13 General Frequency Co-ordination Agreements

There are many internationally agreed plans and procedures for frequency co-ordination in Europe or worldwide, notably for the broadcasting service, the maritime service and the aeronautical service. However, for other services such as the land mobile service for example, there is no general co-ordination mechanism other than the ITU procedures.

In border areas, where all assignments are subject to international co-ordination due to the proximity of foreign stations and where the number of daily assignments is significant and necessitate a quick response to co-ordination requests, multilateral agreements have been developed between concerned countries in order to establish simplified and efficient co-ordination procedures.

This point was mentioned as a possible key issue for this investigation in order to determine whether CEPT should expend resources on developing a generalised detailed co-ordination process and agreement, which could be applicable throughout the CEPT membership. On the actual point in question only one administration felt that this would not be appropriate to the situation in their particular geographical area. Other administrations raised practical and positive suggestions that the principal agreement in place (the Vienna Agreement) should by procedural mechanisms be extended throughout the CEPT.

The DSI Management Team consider that the DSI process is designed to harmonise the use and administration of the radio spectrum throughout Europe. Once this goal is adopted enthusiastically by administrations, an extended Vienna Agreement would seem a natural supplement to the European Table of Allocations and Utilisations.

The DSI Management Team therefore recommend that the Vienna Agreement and other similar Agreements already in place within CEPT countries be studied with a view to implementing a harmonised detailed co-ordination process in border areas for terrestrial radio services operating between 29.7 and 960 MHz.

11.14 Wind Profiler Radars

This item will be debated at a future ITU Conference where the stated requirement is to provide for Wind Profiler Radars in the vicinity of 50, 400 and 1000 MHz. This is a worldwide requirement and the ITU Radiocommunications Sector has already studied the question and has produced a draft report which identifies a number of candidate frequency bands for consideration. Wind profilers are pulse-modulated doppler radars that analyse the structure and the dynamics of the atmosphere up to a height of approximately 30 km. The retrieved signals are used to acquire data about radial velocity and the intensity of turbulence. Several frequencies are needed, because of the frequency dependent dispersion processes of the atmosphere at heights between 100 and 30,000 meters.

In 1993 there were more than 50 wind profilers in operation around the world with the majority being operated by research institutions. Within Europe, wind profilers are operated in Finland, France, Germany, Switzerland and the UK and co-ordinated by COST-74.

There are also acoustic wind profilers on the market as an alternative. According to one manufacturer, the acoustic systems have an average range of 500-1000 metres in a quiet environment.

A system which was brought to the knowledge of the DSI Management Team uses an acoustic pulse which provides the timing information. The actual measurement is achieved with a narrow band CW signal. This equipment is able to determine the wind speed and virtual temperature profiles up to heights of 3 km . This system can be operated within the range 900-2000 MHz

The height range of a 50 MHz wind profiler radar is stated to be in the range 2 to 30 km, a 400 MHz wind profiler 0.5 to 16 km and a 1000 MHz wind profiler 0.16 to 3 km. In addition to the narrow band wind profilers mentioned above it would therefore seem that in terms of the radio resource it is necessary to introduce facilities for wind profilers in the vicinity of 50 MHz to cover the upper atmosphere from 2.5 to 30 km. Narrowband wind profilers might also be introduced at 900 MHz to determine accurate information on temperature and wind speeds at lower altitudes.

The DSI Management Team therefore recommend that a band of around 1.6 MHz in the vicinity of 50 MHz be allocated to the met' aid service to provide for the introduction of long range wind profilers. It is further recommended that an allocation for met' aids be introduced in the band 915-920 MHz to provide for narrow band wind profilers.

11.15 Civil and Emergency TETRA

The general interest shown for shared infrastructures and trunking techniques, and the rapid expansion of digital techniques to all sectors of the

telecommunications industry have lead very naturally to the development of digital trunked systems.

Work was initiated 4 years ago by ETSI for the development of a TDMA standard with a 25 kHz channel separation (so called TETRA 25) intended for professional mobile radio networks. In order to support the general move towards European harmonisation, CEPT prepared in parallel Recommendation T/R 22-05 (frequencies for mobile digital trunked systems) which was adopted in 1992. Considerable difficulty has been experienced in finding the common frequency bands below 500 MHz requested by ETSI. This has led to the designation of 4 different bands: 380-400 MHz, 410-430 MHz, 450-470 MHz and 870-888 paired with 915-933 MHz.

Meanwhile the specific requirements (including international operability) of emergency services, especially police and customs, were being discussed by the Schengen group of countries. The interest in Europe wide harmonisation gradually gathered pace and extended to the other emergency services such as fire and ambulance etc. with the result that CEPT administrations agreed upon the designation of the 380-400 MHz band for such applications (Recommendation T/R 02-02: harmonised frequency bands for emergency services).

A further development during 1994 was the question of another technical option for TETRA, based on FDMA and 6.25 kHz channelling. A number of discussions took place concerning whether this type of multiple access technique could best answer some operational needs in some particular situations. Several studies were performed in order to clarify the situation and assist the decision making process.

For a period Europe was therefore moving towards a double solution, TETRA 25 and TETRA 6 with a possible result that the emergency services and non emergency services might be considered separately. The question then arose of whether different frequency bands would have been required for these different types of techniques and services. Since this may have been spectrally inefficient, the goal of a single standard was still a desirable objective. In this context it should be noted that in late 1994 ETSI members have united in support of the 25 kHz TDMA solution for TETRA.

A further point which still remains to be resolved is the question of non emergency TETRA systems in the band 380-400 MHz.

11.16 GSM Extension Bands

GSM networks are in operation or will be introduced in all European countries. The first GSM networks were implemented around 1992. Some of these networks developed so fast that in some European countries more than several hundred thousands of subscribers are already registered per network. The growth rate lasted for more than a year and is constant or even increasing. Operators estimate that in some European countries by the end of this decade more than 10 million subscribers will use GSM services. In

addition, these figures are based on the services currently offered within GSM networks. It can be assumed that when additional services are developed and offered within GSM networks the number of subscribers will increase. It is therefore not unrealistic to assume that in some industrialised European countries, more than 15 million GSM subscribers are to be expected by the end of this century.

From the development of GSM networks it can be estimated that in some European urban and highly industrialised areas, radio channels will become very loaded so that lost calls will be unavoidable if no precautions are taken at an early stage. If no measures are taken the grade of service will consequently decrease which from a subscribers and operators point of view as well as from a regulators standpoint is not acceptable. From experience gained so far this problem will be widespread in many urban and industrialised regions of Europe.

One measure that will improve the situation is the introduction of the GSM half rate CODEC. With the half rate CODEC, almost double the number of subscribers can be served without major changes to the network. The main problem however is when the new half rate CODEC is introduced, millions of terminals with the full rate CODEC are already in operation and will have to be replaced. On the one hand this is an economic problem and on the other hand a logistical problem. No solution for surmounting these problems currently exists.

It is also possible to improve spectrum efficiency and alleviate congestion using the technique of cell splitting, however this can only be implemented within certain limits.

Another step to avoid or to improve the situation is to use the GSM extension bands not only on a national level but also on a harmonised European basis, which suggests therefore that the GSM extension bands should be designated at the European level. This view was expressed by the GSM MoU Group, the European Public Telecommunications Network Operators' Association (ETNO) and by several individual European operators.

Some administrations indicated that the 1800 MHz bands for DCS1800 were considered as extensions of the 900 MHz bands. However, as mentioned in section 8.3, part of the GSM band is heavily used by analogue networks in several countries and is presumably not going to be available for a long time. In such cases, and in addition to satisfying projected traffic requirements, the use of the 900 MHz extension bands could be envisaged by the countries concerned in order to facilitate the transition from analogue networks to GSM.

The DSI Management Team therefore recommend that the CEPT ERC Recommendation T/R 75-02 be revised and a new CEPT ERC Decision be prepared which designates the frequency bands 880-890 MHz paired with 925-935 MHz on a European basis, as extension bands for the GSM digital pan-European communication system (see also section 11.17 below concerning DSRR).

11.17 Digital Short Range Radio (DSRR)

Section 11.16 above has recommended that the bands 888-890 MHz and 933-935 MHz be utilised together with a further two sub-bands totalling 16 MHz for expansion of the GSM cellular system. DSRR is currently designated spectrum in the same sub-bands and is also the subject of a CEPT ERC Decision.

DSRR is a system designed to sit somewhere between citizens band radio and professional PMR. Its origin can be traced back to the mid-1980s when European industry was concerned at the possible use in Europe of inexpensively priced analogue 900 MHz equipment of Far East manufacture pitched at the semi-professional market. The design frequency was not suitable for use in Europe and it was determined that a digital alternative should be developed, subsequently an ETSI standard was approved and administrations committed themselves to providing appropriate 900 MHz frequencies.

A number of factors have conspired to prevent the bringing of DSRR products to market, it is additionally clear that ETSI's GSM and DSRR standards are not compatible.

The DSI Management Team therefore recommend that the CEPT ERC Decision ERC/DEC/(93)01 be abrogated after discussions with ETSI concerning the future of the DSRR standard.

The DSI Management Team were however of the opinion after discussions with ECTEL that some of the original DSRR vision remains alive. Consequently it would seem appropriate to consider, subject to the commitment process outlined in sub-section 4.4 being successfully concluded, a small allocation comprising up to 25, 6.25 kHz two frequency channels in the vicinity of 430 and 438 MHz for a de-regulated professional radio standard.

11.18 Wireless Local Loop (WLL)

This item has been mentioned in contributions coming from industry and operators. The DSI Management Team has recognised the future importance of this subject, but has also had problems understanding the various definitions of WLL.

Due to increased competition in the field of telecommunications this application may expand considerably. There was not enough information available to justify a frequency band for applications in urban areas within this DSI range. For these geographical areas, frequency ranges above this DSI range should be used (see section 8.5). In rural areas the sub-bands 430-432 paired with 438-440 MHz and 450-460 paired with 460-470 MHz are suggested for WLL on a secondary basis.

11.19 Cordless Microphones

Because of the great number of submissions to the DSI requesting harmonised European bands and frequencies for cordless or radio microphones, this subject was promoted to key issue status. Section 10.10.3 covers the matter in detail and it will be noted that because of the large bandwidths requested, it has not proved possible to meet the largest requirements in their entirety concerning pan-European harmonised radio microphone frequencies.

However it is hoped that some of the solutions proposed and reflected in Annex A will provide sufficient European harmony to facilitate this important component of the European radiocommunications industry.

12. New Approaches to Spectrum Management

12.1 Introduction

In accordance with its terms of reference this phase of the DSI has to study the current and foreseen use of the band 29.7 to 960 MHz and the way that the band is managed and administered in Europe.

In this context, the objective is to ensure that those having interest in the radio spectrum derive maximum benefit from it, in simple terms, meet all requirements at minimum cost. On the other hand those arguing that economic factors should apply to spectrum usage are likely to have an overall objective of maximising the economic benefit from the use of the spectrum.

This is a fundamental difference in philosophy and it will come as no surprise that the DSI Management Team in reviewing the use of pricing mechanisms in spectrum management have decided to adhere closely to the objective of the DSI i.e. maximum use at minimum costs. Nevertheless the use of pricing as a tool can be considered in competitive licensing situations as an incentive to reinforce administrative decisions (refarming the spectrum) and in the fixing of fee structures that cover administrative costs.

This chapter therefore includes a discussion on the economics of spectrum management in general terms and then considers what is believed to be an appropriate future spectrum management policy for consideration by CEPT administrations.

12.2 Background

In most CEPT countries, the licence fee structures are strictly controlled , and to change the process may require changes in primary legislation. Three regimes are in operation. Firstly, some countries set fees at levels that do not reflect the costs of regulating the spectrum, i.e. the taxpayer may subsidise the management process; other countries set fee levels according to the direct cost involvement in management, whilst others are able to include indirect costs as well. It is assumed that currently there is little scope in CEPT countries for using existing legislative process to introduce pricing policy as an instrument for achieving more efficient spectrum use. Outside Europe, countries such as Canada and Australia have greater freedom as licence fee revenues in some cases exceed the cost of administration.

12.3 Options

In the consideration of new mechanisms for frequency management, there are three options for CEPT countries:

- leave things as they are, with spectrum management and licensing policy based on administrative and regulatory processes. However, some attempt might be made to harmonise philosophies and the models used to set licence fees.

- introduce a mixed administrative and market system.

- introduce a market system.

These options are addressed in more detail in the following paragraphs especially in respect of events taking place in other developed countries.

12.4 Why consider Change?

Telecommunications, including the management of the radio spectrum, has in recent years attained a high political profile. Further, purely on grounds of principle, the consideration of introducing market forces in various governmental activities has become a feature of administration in some CEPT countries. Additionally, in some geographical areas, in some frequency bands and for some radio services, there has been a growth in demand for frequencies which, in theory at least, exceeds the available supply. For this reason, market forces could be introduced to attempt to resolve the question of which users might have access to the spectrum. Conversely, some parts of the radio spectrum are less congested and it may be argued that the reduction of fees below the cost recovery level could stimulate interest, thus relieving the pressure on more popular frequency bands.

12.5 Maintenance of the Existing System

There are a number of means to improve existing administrative regulatory activities, although consideration could also be given to the encouragement of user participation in the management of certain assignments or allocations to seek to improve spectrum efficiency for the benefit of all.

There is however evidence that despite recessionary pressures in recent years, growth has continued in the telecommunications sector, it is therefore by no means certain that there will be sufficient spectrum resources available to meet the demands of the next millennium! Staying with this theme, Canada has recently undertaken a detailed review, including public consultations, concerning its current regulatory system. The review concluded that with a small amount of ‘fine tuning’, and with a pragmatic approach to the future, no major or radical changes were required. As occurs now, Canada will in the future implement fees for mobile users to recover, or more than cover, direct costs for regulating non-congested frequency bands and assignments in rural areas. However, more will be charged in the conurbations as a consequence of more intensive use. The Canadians further concluded that in their opinion, there was little to be gained in management terms from lotteries or auctions.

12.6 A Market Philosophy

The most radical philosophy open to administrations is the adoption in whole, or in part, of a market based system based on auctions or lotteries. The developments in New Zealand and Australia are often cited in this regard, but care must be taken in translating the Pacific experience to the European situation, since in both these countries, co-ordination with neighbouring countries is not a problem, and congestion as experienced in the major European conurbations is not an issue.

12.6.1 Auctions or Competitive Bidding

Here the price of spectrum is set by the individual users bidding for licences which would entitle the holder to operate a radiocommunications system under certain specified conditions. In New Zealand, the second price sealed-bid (Vickrey) system has been used to bid for spectrum where interference criteria have been legally defined. This was done to ensure that bidders are clear on the 'parameters' of the item for which they are bidding; this is of course especially problematical if the auction process is to be used for new assignments in bands already heavily utilised.

The second bid system has also been criticised because of the large differentials that can occur between the highest bid and the second bid which, in the most extreme case in New Zealand , was a factor of 10 below the highest price offered. As mentioned in a previous paragraph, Australia is also introducing competitive bidding for the selection of licensees in designated bands where demand/ congestion is high. It is anticipated that existing licensees will be given the opportunity to bid for their radio licence or for less popular tranches of spectrum in order to cover the costs of the regulatory administration.

The United States is the most recent country to have embodied competitive bidding in its radio regulatory process. During August 1993, legislation was enacted which fundamentally amends the 1934 Communications Act with the overall goal of raising around $10.2 billion over the following 5 years. This will be achieved by spectrum auctions and is seen as a key factor in the development and implementation of PCS. Discretionary authority was given to the FCC to develop competitive bidding methodologies which include safeguards to protect the public interest. These were developed during 1993 and in summer 1994 simultaneous multiple round auctions were held for narrowband nation-wide licences using 787.5 kHz of spectrum in the 900 MHz band which raised $617 million and open outcry auctions for Interactive Video and Data Service licences in the band 218-219 MHz, realising $249 million. A further round of auctions for 900 MHz narrowband regional licences in November 1994 raised $489 million. Industry analysts in the US are speculating that the forthcoming broadband auctions for 120 MHz of 2 GHz spectrum could net between $10 billion and $50 billion.

Turning to Europe, competitive bidding has already been used in several CEPT countries, in the United Kingdom for regional commercial television franchises, i.e. a regional licence to broadcast television, and in Eastern

Europe, where some cellular radio licences have been ‘auctioned’ to foreign investors, to provide capital for investment in the public network.

12.6.2 Lotteries

In a lottery system, all eligible candidates have an equal chance of being selected. As in an auction, the ‘product’ has to be carefully and accurately defined. Such a process was used in the United States between 1984 and 1989 for cellular radio licences. However, this system has been somewhat discredited because of the many dummy applications lodged, and the resulting speculation arising from the secondary resale of licences.

12.6.3 Secondary Resale

Section 12.6 would not be complete without mention of the ‘secondary’ market that is likely and probably desirable in a market based spectrum management system, in other words, spectrum licences are a tradable commodity. This underlines the intention that a spectrum allocation, assignment or franchise is a prize worth having. Although this assumption is generally correct, some licences may not realise their full potential. If the regulator is not to be left with licensees unable to develop the spectrum's true potential, licences must be transferable. Both Australia and New Zealand have introduced this possibility into their process, and the United States has also included secondary resale for the cellular licensees with questionable success (see 12.6.2 above).

12.7 A Mixed System

It is of course possible to mix elements of today's classical regulatory régime with elements of the various market based techniques. Japan has already taken this route. A practical proposal to set market sensitive licence fees could comprise of two elements, the first would include the cost of direct and indirect administration of all licences according to an agreed formula. A second element could then be introduced which could be classified as the ‘pricing factor’. This could be a negative value in the case of unpopular spectrum, or where an administration wishes to encourage users to new frequency bands, a zero value for non-congested frequencies where demand for spectrum is low, or a positive value where spectrum is in great demand and congestion is high. In this case, the positive pricing factor could be based on additional criteria:

- per MHz and per band, the latter based on current demand
- the number of assignments involved
- the geographical location
- the coverage area required e.g. power requested and protection required.

It would also be possible to dispense with the first element outlined above, and develop a pricing system based on the additional criteria, i.e. fee formulas. A problem then arises that efficient spectrum management requires

the determination of a price, equal to marginal willingness to pay for assignments. In most cases where ‘unused’ spectrum becomes available, it may also prove possible to decide the successful applicants by competitive bidding/lotteries rather than by beauty competitions, where licence applications are judged on their technical, financial, administrative and operational merits.

It could be postulated that adopting a mixed system as outlined above would avoid some of the economic anomalies which are present in current regulatory licensing régimes.

The first anomaly is known as the ‘differential rent’, which affects a new spectrum entrant much more than an incumbent. The latter's costs have often been sunk in a cheaper technology operating in a lower frequency band than available to the new entrant, whose higher investment may form an effective barrier to successful market entry.

The second anomaly, the ‘scarcity rent’, arises if the dearth of spectrum is such that the prices for use can be increased greatly above cost by a communication service provider.

12.8 Recent European Developments

In the last twelve months an extremely interesting initiative has taken place in the United Kingdom with the issue of a consultative document entitled ‘the Future Management of the Radio Spectrum’.

The document contains a chapter which describes a possible policy for change and invites comments on, *inter alia,* the introduction of a pricing mechanism for the assignment of heavily oversubscribed rights to spectrum use. In addition the United Kingdom administration held a seminar with the title ‘Taking Spectrum Management Into the Future’ one session of which addressed many of the pricing issues.

This was seen as a very important step by the DSI Management Team and it is hoped that the results of the public consultation and UK government considerations will help to facilitate the determination of policy and the basic objectives of European spectrum management.

12.9 Future Policy

This phase of the DSI has focused on satisfying the requirements for spectrum where and when required by encouraging geographical sharing between major groups of users.

If this can be achieved there seems little incentive to introduce major changes in the spectrum management regime by the introduction of auctions and lotteries. In any event it is not certain that the probable large amounts of funds which might accrue from such an exercise will end up facilitating efficient spectrum management.

However DSI Phase I raised the principle that all spectrum users should contribute to the cost of efficient spectrum management and this was endorsed by the DSI Phase II Management Team.

It is therefore recommended that CEPT administrations that have not already actioned the relevant DSI Phase I recommendation, reflect the direct and indirect costs of spectrum management in licence fees and charges to all spectrum users, including those still retaining monopoly privileges.

The DSI Management Team recognise that political decisions and changes in primary legislation may be required to resolve this matter, but it is at least hoped that CEPT administrations are drawing their Ministers' attention to these issues.

How licence fee structures are established within such a policy is a difficult and complicated matter, but a possible differential licensing philosophy is described below. This should have the objective of ensuring that small users (regardless of the radio service) are not disadvantaged by the spectrum management process. Ideally fees should be established according to a logical set of criteria for example:

- the global cost of the CEPT radio regulatory administration to be recovered,
- the amount of administrative work involved in regulating the radio service in question,
- the characteristic (low VHF, high VHF, UHF etc.) of the spectrum used,
- the amount of spectrum required by the individual operators radio system,
- the number of additional users and their fees contributing to the administrative costs of the administration,
- the geographical area covered by the individual users' radio systems,
- any incentive licensing factor (see Section 4.4),
- an anomaly factor to avoid unrealistic distortions if the per MHz per square kilometre factor predominates,
- a channelling load factor and
- a factor reflecting the efficiency of 'in house' frequency management expertise.

Although it is considered preferable to harmonise fee structures on a European basis to avoid the significant price discrepancies that now occur, the DSI Management Team considered this an impractical proposition, but would however see merit in agreeing basic criteria and the relationship between individual elements of the licence fee at the European level.

The DSI Management Team therefore recommend that studies already in progress on establishing licence fee structures within CEPT countries be accelerated and that the elements which are used to formulate fees be harmonised on a European basis.

In order to facilitate the spectrum management process in CEPT countries the following policy guidelines are also recommended by the DSI Management Team:

- **in general radio licensing policies for assigning radio frequencies and authorising radio systems should continue on a 'first-come, first-served' basis with appropriate consideration and responsiveness to new service demands and overall objectives,**

- **once radio systems have been licensed, administrations should ensure that they are implemented within a reasonable time and radio frequencies are efficiently utilised,**

- **where existing users have to be transferred to alternative spectrum, the refarming strategy and compensation mechanism recommended in Section 4.4 be implemented, the incentive licensing element to be considered part of the overall fee criteria,**

- **for competitive licensing, where the available spectrum is inadequate to satisfy all demands, or where it is necessary to limit the number of new entrants, the administrative comparative approach (beauty contests) should be used to select licensees from qualified applicants,**

- **if other market based approaches are eventually considered necessary, an appropriate mechanism should be established after full public consultation, preferably on a European basis,**

- **the radio spectrum should continue to be managed by agencies (see section 13.8) directly responsible to government Ministers but delegated responsibility for planning and frequency assignments could be considered for specialised user groups, for example police and fire, defence, ancillary broadcasting etc. where such delegation is seen to be in the public interest,**

- **emphasis should be placed on efficient spectrum utilisation, by applying adequate planning techniques and spectrum efficient technologies,**

- **the research and development of efficient spectrum usage should be encouraged.**

13. Review of DSI Phase I

It was determined early in the consideration of DSI Phase II that the recommendations of DSI Phase I, many of which have been adopted by the ERC, should be reviewed for their applicability and possible refinement vis-à-vis the lower frequencies considered in the DSI Phase II frequency range.

The relevant paragraphs of chapter 9 of the DSI Phase I results document can be found at Annex I, the following sections in this chapter address the sections of Annex I.

13.1 European Table of Frequency Allocations and Utilisations

In addition to the Table produced in the DSI Phase I process which are about to be agreed with modifications following an extensive study by Working Group FM lasting just over 2 years, an ERC Report has been published detailing the arrangements for the intermediate band 960-3400 MHz. This band may be the subject of a future DSI phase. The DSI Phase II Management Team fully endorses the progress towards an integrated and complete European Table of Frequencies and Utilisations covering as a minimum the range 29.7 MHz to 105 GHz.

13.2 Realisation of the Table

The DSI Management Team recognises the need to establish an appropriate procedure for the implementation of the Table and would particularly support the notion of immediate implementation of proposals if practical and feasible.

13.3 Block Allocations

DSI Phase I recommended that the provision of large block allocations to individual users be kept to a minimum.

The ERC accepted this Recommendation in principle and stressed its importance where terrestrial radio services are concerned.

The ERC also made reference to the case of space radiocommunication services to which the general recommendation in DSI Phase I, does not necessarily apply. Actually, the Recommendation concerning block allocations is mainly aimed at large and exclusive allocations where authority is given to the beneficiary whether or not to authorise access to the block, whatever the spectrum occupancy or the real operational requirements.

The spectrum covered by Phase II of the DSI could be considered as less concerned by this Recommendation by virtue of the extremely intense use of the spectrum and the very limited number of large exclusive block allocations made to individual users. In fact, such situations mainly concern the Defence allocations (as long as the broadcasting and public cellular bands are not considered as allocated to any one individual user).

On the other hand, considering the extreme difficulty encountered in satisfying the growing demands for access to spectrum in the DSI Phase II frequency range, this Recommendation might still be considered particularly appropriate.

13.4 Common Use of Spectrum by Defence and Civil Systems

The DSI Management Team believe that the arrangement outlined in Section 11.8 is a refinement of the recommendation contained in Section 9.6 of Annex I.

13.5 Defence Community

This recommendation is particularly supported and is considered vital in progressing towards the scenario outlined in Section 11.8.

13.6 Research Programmes

This recommendation is supported.

13.7 Enhanced Databases and Improved Computer Assistance

This recommendation is supported.

13.8 Resourcing Administrations

This recommendation is supported in order to improve the spectrum management process in all parts of the spectrum, the process outlined in section 12.9 is seen as a refinement of this recommendation.

13.9 National DSIs and Market Research

The DSI Phase II Management Team would wish to strongly underline the need for consultation, market research and reviews of spectrum and its administration at the national level. Those inputs to this DSI Phase from administrations that had implemented this recommendation were of a particularly high quality.

13.10 Co-operation with ETSI and the EU

This recommendation is endorsed by the DSI Management Team.

Annex A:

PROPOSAL FOR A

EUROPEAN TABLE OF FREQUENCY ALLOCATIONS AND UTILISATIONS IN THE BAND 29.7 MHz TO 960 MHz EXPECTED BEYOND THE YEAR 2008

EXPLANATORY NOTES TO THE TABLE

The heading of this table includes five columns, with the following contents:

Column 1: Frequency Band (MHz)

Indicates the frequency band referred to in that row of the table

Column 2: RR Allocations and relevant footnotes

Contains in each frequency band:

- Current RR Art.8 allocations which correspond to Region 1.
- Current RR Art.8 footnotes relevant to CEPT member countries.
- Underlined footnotes are additional allocations to one or more CEPT member countries

Column 3: European Common Allocation (ECA)

Contains in each frequency band:

- Allocations of major use or major interest in CEPT member countries expected beyond 2008.
- RR Art. 8 footnotes affecting a major number of CEPT countries beyond 2008.

Column 4: Major utilisations

This column includes where appropriate in each frequency band and for the services allocated in the European Common Allocation:

- The major uses in CEPT member countries expected beyond 2008.
- Mention of relevant CEPT Recommendation and/or ERC Decisions approved by the ERC.
- Mention of systems expected to be in use in a major number of CEPT member countries beyond the year 2008.

Mention of specific utilisations of a given service does not preclude the use of other services mentioned in the European Common Allocation.

Column 5: Notes

This column indicates where appropriate in each frequency band:

- The date in which the CEPT Recommendations and/or ERC Decisions mentioned in the utilisations have been approved by the CEPT/ERC.
- The date of entry into force of:
    a) a specific allocation of the European Common Allocation column
    b) CEPT Recommendation / ERC Decision mentioned in the utilisations column.
    c) major utilisation contained in the utilisation column.
- Any other relevant information

Due to the fact that the frequency information is stored in a Paradox database, it has not been possible to compare the RR allocation and the ECA column in this Word table. The comparison table can be found be in the printed version of the document.

29.7000 - 30.0050 MHz	MOBILE	CNR Cordless microphones	
30.0050 - 30.0100 MHz	MOBILE	CNR Cordless microphones	
30.0100 - 37.5000 MHz	MOBILE	CNR Cordless microphones 30.01 - 34.90 MHz Model control 34.990 - 35.225 MHz	
37.5000 - 38.2500 MHz	MOBILE except Aeronautical Mobile Radio Astronomy	CNR RA Interferometry	EU3
38.2500 - 39.9860 MHz	MOBILE	CNR	
39.9860 - 40.0200 MHz	MOBILE Space Research	CNR	
40.0200 - 40.6600 MHz	MOBILE	CNR	
40.6600 - 40.7000 MHz	MOBILE Amateur	CNR ISM General LPD T/R 01-04	EU100 Amateur service limited to propagation beacons Recommendation revised by ERC in 1992
40.7000 - 40.9800 MHz	MOBILE	CNR	
40.9800 - 41.0150 MHz	MOBILE Space Research	CNR	
41.0150 - 44.0000 MHz	MOBILE Fixed	CNR	Fixed limited to trans horizon meteor scatter (MS) systems
44.0000 - 46.4000 MHz	MOBILE Fixed	CNR	Fixed limited to trans horizon meteor scatter (MS) systems
46.4000 - 47.0000 MHz	MOBILE except Aeronautical Mobile METEOROLOGICAL AIDS	CNR Wind profilers	
47.0000 - 48.0000 MHz	MOBILE except Aeronautical Mobile METEOROLOGICA	CNR Wind profilers	EU104

	L AIDS		
48.0000 - 48.5000 MHz	LAND MOBILE	CNR SAB	EU104
48.5000 - 50.0000 MHz	LAND MOBILE	General LPD 49.50 - 50.00 MHz On-site paging 48.50 - 49.50 MHz T/R 02-01	EU104 Recommendation adopted by CEPT in 1986
50.0000 - 51.0000 MHz	AMATEUR		EU104
51.0000 - 52.0000 MHz	AMATEUR LAND MOBILE	CNR	EU104
52.0000 - 54.0000 MHz	LAND MOBILE	CNR PMR SAB	EU104 Single frequency
54.0000 - 61.0000 MHz	BROADCASTING LAND MOBILE	CNR PMR SAB	EU104 Single frequency
61.0000 - 64.5000 MHz	BROADCASTING LAND MOBILE	CNR PMR T/R 02-01	EU104 ML, paired with 64.50 - 68.00 MHz The band intended to facilitate implementation of band arrangement 68 - 87.5 MHz Recommendation adopted by CEPT in 1986
64.5000 - 68.0000 MHz	BROADCASTING LAND MOBILE	CNR PMR T/R 02-01	EU104 FB, paired with 61.00 - 64.50 MHz The band intended to facilitate implementation of band arrangement 68 - 87.5 MHz Recommendation adopted by CEPT in 1986
68.0000 - 69.9500 MHz	MOBILE	CNR PMR T/R 25-08, Annex 2	ML, paired with 77.80 - 79.75 MHz Recommendation adopted by CEPT in 1989
69.9500 - 70.4500 MHz	MOBILE Amateur	CNR Single frequency PMR	Administrations invited to identify a minimum of 100 kHz for the amateur service within the band 70 to 70.45 MHz on a secondary and non exclusive basis preferably centred on 70.2 MHz

			70.00 - 70.15 MHz propagation beacons
70.4500 - 74.8000 MHz	MOBILE except Aeronautical Mobile Radio Astronomy	CNR PMR RA 73.00 - 74.60 MHz for solar wind monitoring T/R 25-08, Annex 2	ML, paired with 80.25 - 84.60 MHz Recommendation adopted by CEPT in 1989
74.8000 - 75.2000 MHz	AERONAUTICAL RADIONAVIGATION MOBILE	ILS/Glide path	Mobile will not be implemented until close down of glide path requirement
75.2000 - 77.7000 MHz	MOBILE	CNR PMR T/R 25-08, Annex 2	ML, paired with 85.00 - 87.50 MHz Recommendation adopted by CEPT in 1989
77.7000 - 77.8000 MHz	MOBILE	CNR Single frequency PMR T/R 25-08, Annex 2	Recommendation adopted by CEPT in 1989
77.8000 - 79.7500 MHz	MOBILE	CNR PMR T/R 25-08, Annex 2	FB, paired with 68.00 - 69.95 MHz Recommendation adopted by CEPT in 1989
79.7500 - 80.2500 MHz	MOBILE except Aeronautical Mobile RADIO ASTRONOMY	CNR Single frequency PMR RA for solar wind monitoring	EU3
80.2500 - 84.6000 MHz	MOBILE	CNR PMR T/R 25-08, Annex 2	FB, paired with 70.45 - 74.20 MHz Recommendation adopted by CEPT in 1989
84.6000 - 85.0000 MHz	MOBILE	CNR Single frequency PMR	
85.0000 - 87.5000 MHz	MOBILE	CNR PMR T/R 25-08, Annex 2	FB, paired with 75.20 - 77.70 MHz Recommendation adopted by CEPT in 1989
87.5000 - 97.5000 MHz	BROADCASTING Mobile	FM sound broadcasting Geneva Agreement 1984	Mobile use in the band 87.5 to 97.5 MHz not envisaged before 2020 and subject to review after the introduction of T-DAB into the band 216 - 240 MHz
97.5000 -	BROADCASTING	FM sound	This band is

100.0000 MHz		broadcasting Geneva Agreement 1984	intended only for local and community broadcasting after the transition period
100.0000 - 108.0000 MHz	BROADCASTING	FM sound broadcasting Geneva Agreement 1984	This band is intended only for local and community broadcasting after the transition period
108.0000 - 112.0000 MHz	AERONAUTICAL RADIONAVIGATION MOBILE	ILS/VOR	Mobile will not be implemented until close of ILS/VOR requirement
112.0000 - 117.9750 MHz	AERONAUTICAL RADIONAVIGATION	VOR	
117.9750 - 121.4900 MHz	AERONAUTICAL MOBILE (R) Mobile except Aeronautical Mobile (R)		EU102 Aeronautical mobile comms for safety, regularity of flight, airline business and airport mobile communications
121.4900 - 121.5100 MHz	SAFETY MOBILE-SATELLITE (Earth-space) AERONAUTICAL MOBILE (R) RR501 RR593	EPIRB	Band only available for distress and safety applications
121.5100 - 136.0000 MHz	AERONAUTICAL MOBILE (R) Mobile except Aeronautical Mobile (R)		EU102 Aeronautical mobile comms for safety, regularity of flight, airline business and airport mobile communications
136.0000 - 137.0000 MHz	AERONAUTICAL MOBILE (R) MOBILE except Aeronautical Mobile (R)	Expansion band for aeronautical mobile comms for safety, regularity of flight, airline business and airport mobile communications	One channel to be identified for air sports
137.0000 - 137.0250 MHz	METEOROLOGICAL-SAT (space-Earth) MOBILE-SATELLITE (space-Earth) Space Operation (space-Earth) Space Research (space-Earth)	Meteorological Satellite Low earth orbiting satellites	EU105

	Mobile RR599B		
137.0250 - 137.1750 MHz	METEOROLOGICAL-SAT (space-Earth) MOBILE-SATELLITE (space-Earth) Space Operation (space-Earth) Space Research (space-Earth) Mobile RR599B	Meteorological Satellite Low earth orbiting satellites	EU105
137.1750 - 137.8250 MHz	METEOROLOGICAL-SAT (space-Earth) MOBILE-SATELLITE (space-Earth) Space Operation (space-Earth) Space Research (space-Earth) Mobile RR599B	Meteorological Satellite Low earth orbiting satellites	EU105
137.8250 - 138.0000 MHz	METEOROLOGICAL-SAT (space-Earth) MOBILE-SATELLITE (space-Earth) Space Operation (space-Earth) Space Research (space-Earth) Mobile RR599B	Meteorological Satellite Low earth orbiting satellites	EU105
138.0000 - 142.0000 MHz	AERONAUTICAL MOBILE (OR) LAND MOBILE Space Research (space-Earth)	Air operations control General LPD	EU102 One12.5 kHz channel to be identified for elderly persons alarm systems
142.0000 - 143.6000 MHz	MOBILE except Aeronautical Mobile	PMR Defence mobile	ML, paired with 152.00 - 153.60 MHz
143.6000 - 143.6500 MHz	MOBILE except Aeronautical Mobile Space Research (space-Earth)	PMR Defence mobile	ML, paired with 153.60 - 153.65 MHz
143.6500 - 144.0000 MHz	MOBILE except Aeronautical Mobile	PMR Defence mobile	ML, paired with 153.65 - 154.00 MHz
144.0000 -	AMATEUR		

146.0000 MHz	AMATEUR-SATELLITE		
146.0000 - 148.0000 MHz	MOBILE	PMR	ML, paired with 154.00 - 156.00 MHz
148.0000 - 149.9000 MHz	MOBILE-SATELLITE (Earth-space) Mobile RR599B	Low earth orbiting satellites Single frequency PMR Defence mobile	EU105
149.9000 - 150.0500 MHz	MOBILE-SATELLITE (Earth-space) Mobile RR599B	Low earth orbiting satellites Single frequency PMR Defence mobile	EU105
150.0500 - 151.4000 MHz	MOBILE except Aeronautical Mobile RADIO ASTRONOMY	Single frequency PMR Defence mobile RA continuum measurement and pulsar/solar observation	EU3
151.4000 - 152.0000 MHz	MOBILE except Aeronautical Mobile RADIO ASTRONOMY	RA continuum measurement and pulsar/solar observation Defence mobile Single frequency PMR	EU3
152.0000 - 153.0000 MHz	MOBILE except Aeronautical Mobile RADIO ASTRONOMY	PMR Defence mobile RA continuum measurement and pulsar/solar observation	EU3 FB, paired with 142.00 - 143.00 MHz
153.0000 - 154.0000 MHz	MOBILE except Aeronautical Mobile	PMR Defence mobile	FB, paired with 143.00 - 144.00 MHz
154.0000 - 156.0000 MHz	MOBILE	PMR	FB, paired with 146.00 - 148.00 MHz
156.0000 - 156.7625 MHz	MOBILE except Aeronautical Mobile RR501 RR613 RR613A	RR Appendix 18 156.000 - 156.375 MHz International maritime ship tx 156.3750 - 156.7625 MHz single frequency maritime 156.525 MHz digital selective call for distress, safety and calling T/R 25-08, Annex 2	Ship station, paired with 160.600 - 160.975 MHz ML, paired with 160.6000 - 161.3625 MHz Recommendation adopted by CEPT in 1989
156.7625 -	SAFETY	International	

156.8375 MHz	MARITIME MOBILE	distress, safety and call frequency + guard bands	
156.8375 - 157.9500 MHz	MOBILE except Aeronautical Mobile	RR Appendix 18 156.8375 - 156.8750 MHz single frequency maritime 156.875 - 157.450 MHz international maritime ship station tx 157.450 - 157.950 MHz private maritime ship station tx T/R 25-08, Annex 2	Ship station/ML, paired with 161.4375 - 162.5500 MHz Recommendation adopted by CEPT in 1989
157.9500 - 160.6000 MHz	MOBILE except Aeronautical Mobile	RR Appendix 18 T/R 25-08, Annex 2	ML, paired with 162.550 - 165.200 MHz Recommendation adopted by CEPT in 1989
160.6000 - 162.5500 MHz	MOBILE except Aeronautical Mobile	RR Appendix 18 160.600 - 160.975 MHz international maritime coast station tx 160.975 - 161.475 MHz single frequency land/maritime 161.475 - 162.050 MHz international maritime coast station tx 162.050 - 162.550 MHz private maritime coast station tx T/R 25-08, Annex 2	FB, paired with 156.000 - 157.950 MHz Coast station, paired with 156.000 - 156.375 and 156.875 - 157.450 MHz Recommendation adopted by CEPT in 1989
162.5500 - 165.2000 MHz	MOBILE except Aeronautical Mobile	PMR T/R 25-08, Annex 2	FB, paired with 157.950 - 160.600 MHz Recommendation adopted by CEPT in 1989
165.2000 - 169.4000 MHz	MOBILE except Aeronautical Mobile	PMR T/R 25-08, Annex 2	ML, paired with 169.800 - 174.000 MHz Recommendation adopted by CEPT in 1989
169.4000 - 169.8000 MHz	MOBILE	ERMES CEPT/ERC/DEC(94) 02	Decision adopted by ERC in 1994 Recommendation

		T/R 25-08, Annex 2	adopted by CEPT in 1989
169.8000 - 174.0000 MHz	LAND MOBILE	PMR T/R 25-08, Annex 2	FB, paired with 165.2 - 169.4 MHz Recommendation adopted by CEPT in 1989
174.0000 - 175.5000 MHz	BROADCASTING LAND MOBILE	Stockholm Agreement 1961 Cordless microphones T/R 25-05	EU103 Recommendation adopted by CEPT in 1985
175.5000 - 183.5000 MHz	BROADCASTING LAND MOBILE	Stockholm Agreement 1961 PMR T/R 25-05	EU103 FB, paired with 183.5 - 191.5 MHz Recommendation adopted by CEPT in 1985
183.5000 - 191.5000 MHz	BROADCASTING LAND MOBILE	Stockholm Agreement 1961 PMR T/R 25-05	EU103 ML, paired with 175.5 - 183.5 MHz Recommendation adopted by CEPT in 1985
191.5000 - 199.5000 MHz	BROADCASTING LAND MOBILE	Stockholm Agreement 1961 PMR T/R 25-05	EU103 ML, paired with 199.5 - 207.5 MHz Recommendation adopted by CEPT in 1985
199.5000 - 207.5000 MHz	BROADCASTING LAND MOBILE	Stockholm Agreement 1961 PMR T/R 25-05	EU103 FB, paired with 191.5 - 199.5 MHz Recommendation adopted by CEPT in 1985
207.5000 - 216.0000 MHz	BROADCASTING LAND MOBILE	Stockholm Agreement 1961 SAB	EU103
216.0000 - 223.0000 MHz	BROADCASTING	T-DAB Wiesbaden Agreement 1995	
223.0000 - 230.0000 MHz	BROADCASTING	T-DAB Wiesbaden Agreement 1995	
230.0000 - 235.0000 MHz	BROADCASTING Mobile	T-DAB Wiesbaden Agreement 1995	EU101 T-DAB sharing with defence in time of crisis
235.0000 - 240.0000 MHz	BROADCASTING Mobile	T-DAB Wiesbaden	EU101 T-DAB sharing with

		Agreement 1995	defence in time of crisis
240.0000 - 242.9900 MHz	MOBILE		EU101 EU102
242.9900 - 243.0100 MHz	SAFETY MOBILE	EPIRB	
243.0100 - 267.0000 MHz	MOBILE MOBILE-SATELLITE Radiolocation		EU101 EU102
267.0000 - 272.0000 MHz	MOBILE MOBILE-SATELLITE Radiolocation		EU101 EU102
272.0000 - 273.0000 MHz	MOBILE MOBILE-SATELLITE Radiolocation		EU101 EU102
273.0000 - 312.0000 MHz	MOBILE MOBILE-SATELLITE Radiolocation		EU101 EU102
312.0000 - 315.0000 MHz	MOBILE MOBILE-SATELLITE Radiolocation		EU101 EU102
315.0000 - 322.0000 MHz	MOBILE MOBILE-SATELLITE Radiolocation		EU101 EU102
322.0000 - 328.6000 MHz	MOBILE except Aeronautical Mobile MOBILE-SATELLITE (Earth-space) RADIO ASTRONOMY		EU101 EU102
328.6000 - 335.4000 MHz	AERONAUTICAL RADIONAVIGATION MOBILE	ILS/Glide path	Mobile will not be implemented until close down of glide path requirement
335.4000 - 380.0000 MHz	MOBILE MOBILE-SATELLITE Radiolocation		EU101 EU102
380.0000 - 387.0000 MHz	MOBILE	Digital PMR - TETRA T/R 22-05 T/R 02-02	ML, paired with 390 - 397 MHz Recommendation (T/R 22-05) adopted by ERC in 1992 Recommendation (T/R 02-02) adopted by ERC in 1993
387.0000 -	MOBILE	Digital PMR -	ML, paired with 397

390.0000 MHz		TETRA T/R 22-05 T/R 02-02	- 400 MHz Recommendation (T/R 22-05) adopted by ERC in 1992 Recommendation (T/R 02-02) adopted by ERC in 1993
390.0000 - 399.9000 MHz	MOBILE	Digital PMR - TETRA T/R 22-05 T/R 02-02	FB, paired with 380 - 389.9 MHz Recommendation (T/R 22-05) adopted by ERC in 1992 Recommendation (T/R 02-02) adopted by ERC in 1993
399.9000 - 400.0000 MHz	MOBILE	Digital PMR - TETRA T/R 22-05 T/R 02-02	FB, paired with 389.9 - 390 MHz Recommendation (T/R 22-05) adopted by ERC in 1992 Recommendation (T/R 02-02) adopted by ERC in 1993
400.0000 - 400.0500 MHz	MOBILE	400.025 MHz for future pan-European requirement	
400.0500 - 400.1500 MHz	STANDARD FREQUENCY AND TIME SIGNAL-SATELLITE Mobile		
400.1500 - 401.0000 MHz	METEOROLOGICAL AIDS SPACE RESEARCH (space-space) MOBILE-SATELLITE (space-Earth) MOBILE except Aeronautical Mobile RR599B RR647	Low earth orbiting satellites	EU105
401.0000 - 402.0000 MHz	METEOROLOGICAL AIDS EARTH EXPLORATION-SAT (Earth-space) Mobile except Aeronautical Mobile		
402.0000 - 403.0000 MHz	METEOROLOGICAL AIDS EARTH EXPLORATION-SAT (Earth-space)		

	Mobile except Aeronautical Mobile		
403.0000 - 404.5000 MHz	METEOROLOGICAL AIDS MOBILE except Aeronautical Mobile	General LPD On-site paging	
404.5000 - 406.0000 MHz	METEOROLOGICAL AIDS Mobile except Aeronautical Mobile		
406.0000 - 406.1000 MHz	MOBILE-SATELLITE (Earth-space) SAFETY RR649A RR649	EPIRB	
406.1000 - 410.0000 MHz	LAND MOBILE RADIO ASTRONOMY	SAB RA continuum measurement and pulsar observation	EU3 SAB to protect RA observations
410.0000 - 420.0000 MHz	MOBILE	Digital PMR - TETRA Defence mobile Airport mobile systems T/R 22-05 T/R 25-08, Annex 2	ML, paired with 420 - 430 MHz Recommendation (T/R 22-05) adopted by ERC in 1992 Recommendation (T/R 25-08) adopted by CEPT in 1989
420.0000 - 430.0000 MHz	MOBILE	Digital PMR - TETRA Airport mobile systems Defence mobile T/R 22-05 T/R 25-08, Annex 2	FB, paired with 410 - 420 MHz Recommendation (T/R 22-05) adopted by ERC in 1992 Recommendation (T/R 25-08) adopted by CEPT in 1989
430.0000 - 432.0000 MHz	MOBILE Fixed	PMR Deregulated mobile communications 430.000 - 430.150 MHz, ML WLL in rural areas	ML, paired with 438 - 440 MHz Fixed service limited to WLL
432.0000 - 433.0500 MHz	AMATEUR		
433.0500 - 434.7900 MHz	AMATEUR Land Mobile	ISM General LPD	EU100 ISM to be reviewed
434.7900 - 438.0000 MHz	AMATEUR AMATEUR-SATELLITE		Amateur Satellite Service restricted to 435 - 438 MHz
438.0000 - 440.0000 MHz	MOBILE Fixed	PMR Deregulated mobile communications 438.000 - 438.150 MHz, FB	FB, paired with 430 - 432 MHz Fixed service limited to WLL

		WLL in rural areas	
440.0000 - 445.0000 MHz	MOBILE	PMR Defence mobile	FB, paired with 445 - 450 MHz
445.0000 - 450.0000 MHz	MOBILE	PMR Defence mobile	ML, paired with 440 - 445 MHz
450.0000 - 460.0000 MHz	MOBILE Fixed	On board communications 457.525 - 457.575 MHz (maritime) Digital PMR - TETRA WLL in rural areas T/R 22-05 T/R 25-08, Annex 2 T/R 32-02	ML, paired with 460 - 470 MHz Fixed service limited to WLL Recommendation (T/R 22-05) adopted by ERC in 1992 Recommendation (T/R 25-08) adopted by CEPT in 1989 Recommendation (T/R 32-02) adopted by CEPT in 1976
460.0000 - 470.0000 MHz	MOBILE Fixed Earth Exploration-Sat (space-Earth) RR669	Digital PMR - TETRA On board communications 467.525 - 467.575 MHz (maritime) WLL in rural areas T/R 22-05 T/R 25-08, Annex 2 T/R 32-02	FB, paired with 450 - 460 MHz Fixed service limited to WLL Recommendation (T/R 22-05) adopted by ERC in 1992 Recommendation (T/R 25-08) adopted by CEPT in 1989 Recommendation (T/R 32-02) adopted by CEPT in 1976
470.0000 - 608.0000 MHz	BROADCASTING Mobile	Stockholm Agreement 1961 as modified to support digital television SAB	Band 470 - 510 MHz to be reviewed for possible future PMR applications Analogue TV networks not to be expanded in this band
608.0000 - 614.0000 MHz	BROADCASTING RADIO ASTRONOMY Mobile	Stockholm Agreement 1961 as modified to support digital television SAB	EU3 Analogue TV networks not to be expanded in this band
614.0000 - 790.0000 MHz	BROADCASTING Mobile	Stockholm Agreement 1961 as modified to support digital television SAB	Analogue TV networks not to be expanded in this band
790.0000 - 862.0000 MHz	BROADCASTING Mobile	Stockholm Agreement 1961 as modified to support digital television SAB	Analogue TV networks not to be expanded in this band
862.0000 -	MOBILE	SAB	

875.0000 MHz	Fixed	Cordless microphones	
875.0000 - 876.0000 MHz	MOBILE	PMR	
876.0000 - 880.0000 MHz	MOBILE	PMR UIC railway systems	If 4 MHz not required for UIC then band available for other PMR applications
880.0000 - 890.0000 MHz	MOBILE Fixed	GSM Defence systems	
890.0000 - 915.0000 MHz	MOBILE	GSM CEPT/ERC/DEC(94) 01	Decision adopted by ERC in 1994
915.0000 - 920.0000 MHz	MOBILE METEOROLOGICAL AIDS Amateur Fixed	ISM LPD 915 - 919.5 MHz Amateur 919.5 - 920 MHz New technologies 915 - 919.5 MHz	EU100 Narrow band windprofilers
920.0000 - 921.0000 MHz	MOBILE	PMR	
921.0000 - 925.0000 MHz	MOBILE	PMR UIC railway systems	If 4 MHz not required for UIC then band available for other PMR applications
925.0000 - 935.0000 MHz	MOBILE Fixed	GSM Defence systems	
935.0000 - 942.0000 MHz	MOBILE	GSM CEPT/ERC/DEC(94) 01	Decision adopted by ERC in 1994
942.0000 - 960.0000 MHz	MOBILE	GSM CEPT/ERC/DEC(94) 01	Decision adopted by ERC in 1994

List of abbreviations on the European Table of Frequency Allocations and Utilisations:

CNR	Combat Net Radio
EPIRB	Emergency Position Indicating Radio Beacon
ERMES	European Radio Message System
FB	Base station
GSM	Global System for Mobile Communications
ILS	Instrument Landing System
ISM	Industrial, Scientific and Medical
LPD	Low Power Device
ML	Mobile station
PMR	Professional Mobile Radio
RA	Radio Astronomy
RR	Radio Regulations
SAB	Service Ancillary to Broadcasting
T-DAB	Terrestrial Digital Audio Broadcasting
TETRA	Trans European Trunked Radio
UIC	International Railways Union
VOR	VHF Omnidirectional Radio Range
WLL	Wireless Local Loop

EU Footnotes

EU3:
This band is allocated to the radio astronomy service. CEPT administrations are urged to take all practicable steps to protect the radio astronomy service from harmful interference. Emissions from space or airborne stations in this and adjacent bands can cause serious harmful interference.

EU100:
This band is designated for industrial, scientific and medical (ISM) applications. Radiocommunications services operating in this band must accept harmful interference which may be caused by these applications. Administrations shall take all practicable steps to minimise radiation from ISM equipment and should ensure that any out of band radiation does not cause harmful interference to any radiocommunications service.

EU101:
The mobile service in the band 230-380 MHz generally comprises transportable radio relay, air-ground-air and tactical mobile applications.

EU102:
In this band aeronautical stations and aircraft stations are likely to utilise 8.33 kHz channel spacing for non secure communications requirements.

EU103:
This band in most CEPT countries will not be available to the mobile service on a primary basis before the year 2020 and in any event will be subject to a review. Until that time, in those countries utilising this band for the broadcasting service, the mobile service is available on a secondary basis.

EU104: This band is allocated to broadcasting service in most CEPT countries and will not be available to the mobile service on a primary basis before the year 2020. However, CEPT administrations are currently urged to take all the practical steps to clear this band of assignments to the broadcasting service, starting from the lower end, in order to make possible the introduction of alternative services in the band 47-54 MHz by the year 2008.

EU105:
The mobile-satellite service is limited to low earth orbiting satellites.

Relevant RR Article 8 Footnotes

501 The carrier frequencies 2 182 kHz, 3 023 kHz, 5 680 kHz, 8 364 kHz, 121.5 MHz, 156.8 MHz and 243 MHz may also be used, in accordance with the procedures in force for terrestrial radiocommunication services, for search and rescue operations concerning manned space vehicles. The conditions for use of the frequencies are prescribed in Articles 38 and N38.

The same applies to the frequencies 10 003 kHz, 14 993 kHz and 19 993 kHz, but in each of these cases emissions must be confined in a band of ±3 kHz about the frequency.

547 In making assignments to stations of other services to which the band 37.5 -38.25 MHz is allocated, administrations are urged to take all practicable steps to protect the radio astronomy service from harmful interference. Emissions from space or airborne stations can be particularly serious sources of interference to the radio astronomy service (see Nos. **343** and **344** and Article **36**)

548 The band 40.66 - 40.70 MHz (centre frequency 40.68 MHz) is designated for industrial, scientific and medical (ISM) applications. Radiocommunication services operating within this band must accept harmful interference which may be caused by these applications. ISM equipment operating in this band is subject to the provisions of No. **1815**.

553 Additional allocation: in Hungary, Kenya, Mongolia, Czechoslovakia and the USSR the bands 47 - 48.5 MHz and 56.5 - 58 MHz are also allocated to the fixed and land mobile services on a secondary basis.

554 Additional allocation: in Albania, the Federal Republic of Germany, Austria, Belgium, Bulgaria, Côte d'Ivoire, Denmark, Spain, Finland, France, Gabon, Greece, Ireland, Israel, Italy, Lebanon, Liechtenstein, Luxembourg, Madagascar, Mali, Malta, Morocco, Mauritania, Monaco, Nigeria, Norway, the Netherlands, Poland, the German Democratic Republic, the United Kingdom, Senegal, Sweden, Switzerland, Swaziland, Syria, Togo, Tunisia, Turkey and Yugoslavia, the band 47 - 68 MHz, and in Romania, the band 47 - 58 MHz, are also allocated to the land mobile service on a permitted basis. However, stations of the land mobile service in the countries mentioned in connection with each band referred to in this footnote shall not cause harmful interference to, or claim protection from, existing or planned broadcasting stations of countries other than those mentioned in connection with the band.

564 Alternative allocation: in Bulgaria, Hungary, Poland, Romania and Czechoslovakia, the band 68 - 73 MHz is allocated to the broadcasting service on a primary basis and used in accordance with the decisions in the Final Acts of the Special Regional Conference, Geneva, 1960.

565 Alternative allocation: in Mongolia and the USSR, the bands 68 - 73 MHz and 76 - 87 MHz are allocated to the broadcasting service on a primary basis. The services to which these bands are allocated in other countries and the broadcasting service in Mongolia and the USSR are subject to agreements with the neighbouring countries concerned.

567 Additional allocation: in Bulgaria, Hungary, Mongolia, Poland, Czechoslovakia and the USSR, the band 73 - 74 MHz is also allocated to the broadcasting service on a primary basis. The use of this band by the broadcasting service in Bulgaria, Hungary, Mongolia, Poland, Czechoslovakia and the USSR is subject to agreement obtained under the procedure set forth in Article **14**.

568 In making assignments to stations of other services to which the band 73 - 74.6 MHz is allocated, administrations are urged to take all practicable steps to protect the radio astronomy service from harmful interference. Emissions from space or airborne stations can be particularly serious sources of interference to the radio astronomy service (see Nos. **343** and **344** and Article **36**).

571 Additional allocation: in Bulgaria, China, Mongolia, Poland, Czechoslovakia and the USSR the bands 74.6 - 74.8 MHz and 75.2 - 75.4 MHz are also allocated to the aeronautical radionavigation service, on a primary basis, for ground-based transmitters only.

572 The frequency 75 MHz is assigned to aeronautical marker beacons. Administrations shall refrain from assigning frequencies close to the limits of the guardband to stations of other services which, because of their power or geographical position, might cause harmful interference or otherwise place a constraint on marker beacons.

In the future every effort should be made to improve further the characteristics of airborne receivers and to limit the power of transmitting stations close to the limits 74.8 MHz and 75.2 MHz.

572A Additional allocation: in Afghanistan, the Federal Republic of Germany, Austria, Belgium, Cyprus, Denmark, Egypt, Spain, France, Greece, Israel, Italy, Japan, Jordan, Lebanon, Malta, Morocco, Monaco, Norway, the Netherlands, Portugal, the United Kingdom, Sweden, Switzerland, Syria and Turkey, the band 74.8 - 75.2 MHz is also allocated to the mobile service on a secondary basis subject to agreement obtained under the procedure set forth in Article **14**. In order to ensure that harmful interference is not caused to stations of the aeronautical radionavigation service, stations of

the mobile service shall not be introduced in the band until it is no longer required for the aeronautical radionavigation service by an administration which may be identified in the application of Article **14**.

575 Additional allocation: in Bulgaria, Hungary, Poland, Romania and Czechoslovakia, the band 76 - 87.5 MHz is also allocated to the broadcasting service on a primary basis and used in accordance with the decisions contained in the Final Acts of the Special Regional Conference, Geneva, 1960.

578 Alternative allocation: in Albania, the band 81 - 87.5 MHz is allocated to the broadcasting service on a primary basis and used in accordance with the decisions contained in the Final Acts of the Special Regional Conference, Geneva, 1960.

581 Additional allocation: in the Federal Republic of Germany, France, Ireland, Israel, Italy, Liechtenstein, Monaco, the United Kingdom and Switzerland, the band 87.5 - 88 MHz is also allocated to the land mobile service on a permitted basis and subject to agreement obtained under the procedure set forth in Article **14**.

584 Broadcasting stations in the band 100 - 108 MHz in Regional 1 shall be established and operated in accordance with an agreement and associated plan for the band 87.5 - 108 MHz to be drawn up by a regional broadcasting conference (see Resolution **510**). Prior to the date of entry into force of this agreement, broadcasting stations may be introduced subject to agreement between administrations concerned, on the understanding that such an operation shall in no case prejudice the establishment of the plan.

587 Additional allocation: in Bulgaria, Israel, Kenya, Lebanon, Mongolia, the German Democratic Republic, the United Kingdom, Somalia, Syria, Czechoslovakia, Turkey and the USSR, the band 104 - 108 MHz is also allocated to the mobile, except aeronautical mobile (R), service on a permitted basis until 31 December 1995 and, thereafter, on a secondary basis.

588 Additional allocation: in Finland and Yugoslavia, the band 104 - 108 MHz is also allocated to the fixed service on a permitted basis, until 31 December 1995. the effective radiated power of any station shall not exceed 25 W.

589 Additional allocation: in France, Romania, Sweden and Yugoslavia, the band 104 - 108 MHz is also allocated to the mobile, except aeronautical mobile (R), service on a permitted basis until 31 December 1995.

590A Additional allocation: in Afghanistan, the Federal Republic of Germany, Austria, Cyprus, Denmark, Egypt, Spain, France, Israel, Italy, Japan, Jordan, Lebanon, Malta, Morocco, Monaco, Norway, Pakistan, Portugal, the United Kingdom, Sweden, Switzerland, Syria and Turkey, the band 108 - 111.975 MHz is also allocated to the mobile service on a secondary basis subject to agreement obtained under the procedure set forth in Article **14**. In order to ensure that harmful interference is not caused to stations of the aeronautical radionavigation service, stations of the mobile service shall not be introduced in the band until it is no longer required for the aeronautical radionavigation service by any administrations which may be identified in the application of Article **14**.

591 Subject to agreement obtained under the procedure set forth in Article **14**, the band 117.975 - 137 MHz is also allocated to the aeronautical mobile-satellite (R) service on a secondary basis and on the condition that harmful interference is not caused to the aeronautical mobile (R) service.

592 The bands 121.45 - 121.55 MHz and 242.95 - 243.05 MHz are also allocated to the mobile-satellite service for the reception on board satellites of emissions from emergency position-indicating radiobeacons transmitting at 121.5 MHz and 243 MHz (see Nos. **3259** and **3267**).

593 In the band 117.975 - 136 MHz, the frequency 121.5 MHz is the aeronautical emergency frequency and where required the frequency 123.1 MHz is the aeronautical frequency auxiliary to 121.5 MHz. Mobile stations of the maritime mobile service may communicate on these frequencies under the conditions laid down in Article **38 and N38** for distress and safety purposes with stations of the aeronautical mobile service.

594 Additional allocation: in Angola, Bulgaria, Hungary, Iran, Iraq, Japan, Mongolia, Mozambique, Papua New Guinea, Poland, the German Democratic Republic, Romania, Czechoslovakia an the U.S.S.R., the band 132 -136 MHz is also allocated to the aeronautical mobile (or) service on a permitted basis.

594A Different category of service: as from 1 January 1990, in Bulgaria, Poland, the German Democratic Republic, Romania, Czechoslovakia, Turkey and the USSR, the allocation of the band 136 - 137 MHz to the aeronautical mobile (OR) service is on a permitted basis.

595 Until 1 January 1990, the band 136 - 137 MHz is also allocated to the space operation service (space-to-Earth), meteorological-satellite service (space-to-Earth) and the space research service (space-to-Earth) on a primary basis. The introduction of stations of the aeronautical mobile (R) service shall only occur after that date and shall be effected in accordance with internationally agreed plans for that service. After 1 January 1990, the band 136 - 137 MHz will also be allocated to the above-mentioned space radio-communication services on a secondary basis (see Resolution **408 (mob 87)**).

598 Different category of service: in Austria, Bulgaria, Egypt, Finland, France, Greece, Hungary, the Lebanon, Mongolia, Poland, the German Democratic Republic, Romania, Syria, Czechoslovakia and the USSR, the allocation of the band 137 - 138 MHz to the aeronautical mobile (OR) service is on a primary basis (see No. **425**).

599 Additional allocation: in Australia, the band 137 - 144 MHz is also allocated to the broadcasting service on a primary basis until that service can be accommodated within regional broadcasting allocations.

599A The use of the band 137 - 138 MHz by the mobile-satellite service is subject to the application of the co-ordination and notification procedures set forth in Resolution **46** (**WARC-92**). However, co-ordination of a space station of the mobile-satellite service with respect to terrestrial services is required only if the power flux-density produced by the station exceeds -125 dB(W/m²/4 kHz) at the Earth's surface. The above power flux-density limit shall apply until such time as a competent world administrative radio conference revises it. In making assignments to the space stations in the mobile-satellite service in the above band administrations shall take all practicable steps to protect the radio astronomy service in the 150.05 - 153 MHz band from harmful interference from unwanted emissions.

599B The use of the bands 137 - 138 MHz, 148 - 149.9 MHz and 400.15 - 401 MHz by the mobile-satellite service and the band 149.9 - 150.05 MHz by the land mobile-satellite service is limited to non-geostationary-satellite systems.

600 Additional allocation: in the Federal Republic of Germany, Austria, Belgium, France, Israel, Italy, Liechtenstein, Luxembourg, the United Kingdom, Sweden, Switzerland and Czechoslovakia, the bands 138 - 143.6 MHz and 143.65 - 144 MHz are also allocated to the space research service (space-to-Earth) on a secondary basis.

601 Additional allocation: in the Federal Republic of Germany, Saudi Arabia, Austria, Bahrain, Belgium, Denmark, the United Arab Emirates, Spain, Finland, Greece, Ireland, Israel, Kenya, Kuwait, Liechtenstein, Luxembourg, Mali, Malta, Norway, the Netherlands, Qatar, the United Kingdom, Somalia, Sweden, Switzerland, Tanzania, Tunisia, Turkey and Yugoslavia, the band 138 - 144 MHz is also allocated to the maritime mobile and land mobile services on a primary basis.

604 Additional allocation: in Ethiopia, Finland, Kenya, Malta, Somalia, Sudan, Tanzania and Yugoslavia, the band 138 - 144 MHz is also allocated to the fixed service on a primary basis.

608 Subject to agreement obtained under the procedure set forth in Article **14**, the band 148 - 149.9 MHz may be used by the space operation service (Earth-to-space). the bandwidth of an individual transmission shall not exceed ±25 kHz.

608A The use of the band 148 - 149.9 MHz by the mobile-satellite service is subject to the application of the co-ordination and notification procedures set forth in Resolution **46 (WARC-92)**. The mobile-satellite service shall not constrain the development and use of fixed, mobile and space operation services in the band 148 - 149.9 MHz. Mobile earth stations in the mobile-satellite service shall not produce a power flux density in excess of -150 dB(W/m²/4 kHz) outside national boundaries.

608B The use of the band 149.9 - 150.05 MHz by the land mobile-satellite service is subject to the application of the co-ordination and notification procedures set forth in resolution **46(WARC-92)**. The land mobile satellite service shall not constrain the development and use of the radionavigation-satellite service in the band 149.9 - 150.05 MHz. Land mobile earth stations of the land mobile-satellite service shall not produce power flux-density in excess of -150 dB(W/m²/4 kHz) outside national boundaries.

608C Stations of the mobile-satellite service in the band 148 - 149.9 MHz shall not cause harmful interference to, or claim protection from stations of the fixed or mobile services in the following countries: Algeria, the Federal Republic of Germany, Saudi Arabia, Australia, Austria, Bangladesh, Belarus, Belgium, Brunei Darussalam, Bulgaria, Cameroon, Canada, Cyprus, Colombia, Congo, Cuba, Denmark, Egypt, the United Arab Emirates, Ecuador, Spain, Ethiopia, the Russian Federation, Finland, France, Ghana, Greece, Honduras, Hungary, Iran, Ireland, Iceland, Israel, Italy, Japan, Jordan, Kenya, Libya, Liechtenstein, Luxembourg, Malaysia, Mali, Malta, Mauritania, Mozambique, Namibia, New Zealand, Norway, Oman, Pakistan, Panama, Papua New Guinea, the Netherlands, Philippines, Poland, Portugal, Qatar, Syria, Romania, the United Kingdom, Singapore, Sri Lanka, Sweden, Switzerland, Surinam, Swaziland, Tanzania, Chad, the Czech and Slovak Federal Republic, Thailand, Tunisia, Turkey, Ukraine, Yemen and Yugoslavia that operate in accordance with the Table of Frequency Allocations.

609 Emissions of the radionavigation-satellite service in the bands 149.9 - 150.05 MHz and 399.9 - 400.05 MHz may also be used by receiving earth stations of the space research service.

609A Recognising that the use of the band 149.9 - 150.05 MHz by the fixed and mobile services may cause harmful interference to the radionavigation-satellite service, administrations are urged not to authorise such use in application of No.**342**.

609B In the band 149.9 - 150.05 MHz, the allocation to the land mobile-satellite service shall be on a secondary basis until 1 January 1997.

610 In making assignments to stations of other services to which the band 150.05 - 153 MHz is allocated, administrations are urged to take all practicable steps to protect the radio astronomy service from harmful interference. Emissions from space or airborne stations can be particularly serious sources of interference to the radio astronomy service (see Nos. **343** and **344** and Article **36**).

613 The frequency 156.8 MHz is the international distress, safety and calling frequency for the maritime mobile VHF radiotelephone service. The conditions for the use of this frequency are contained in Articles **38** and **N38**.

In the bands 156 - 156.7625 MHz, 156.8375 - 157.45 MHz, 160.6 - 160.975 MHz and 161.475 - 162.05 MHz, each administration shall give priority to the maritime mobile service on only such frequencies as are assigned to stations of the
maritime mobile service by that administration (see Articles **38, N38** and **60**).

Any use of frequencies in these bands by stations of other services to which they are allocated should be avoided in areas where such use might cause harmful interference to the maritime mobile VHF radiocommunication service.

However, the frequency 156.8 MHz and the frequency bands in which priority is given to the maritime mobile service may be used for radiocommunications on inland waterways subject to agreement between interested and affected administrations
and taking into account current frequency usage and existing agreements.

613A In the maritime mobile VHF service the frequency 156.525 MHz is to be used exclusively for digital selective calling for distress, safety and calling (see resolution **323 (mob 87)**). The conditions for the use of this frequency are prescribed in Articles **38, N38** and **60** and in Appendix **18**.

613B Additional allocation: in Ireland and in the United Kingdom, the band 161.3875 - 161.4125 MHz is also allocated to the maritime radionavigation service on a primary basis, subject to agreement obtained under the procedure set forth in Article **14**

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621 Additional allocation: in the Federal Republic of Germany, Austria, Belgium, Denmark, Spain, Finland, France, Israel, Italy, Liechtenstein, Malta, Monaco, Norway, the Netherlands, the United Kingdom, Sweden and Switzerland, the band 174 - 223 MHz is also allocated to the land mobile service on a permitted basis. However, the stations of the land mobile service shall not cause harmful interference to, nor claim protection from, broadcasting stations, existing or planned, in countries other than those listed in this footnote.

622 Different category of service: in the Federal Republic of Germany, Austria, Belgium, Denmark, Spain, Finland, France, Israel, Italy, Liechtenstein, Luxembourg, Malta, Monaco, Norway, the Netherlands, Portugal, the United Kingdom, Sweden and Switzerland, the band 223 - 230 MHz is allocated to the land mobile service on a permitted basis (see No. **425**). However, the stations of the land mobile service shall not cause harmful interference to, nor claim protection from, broadcasting stations, existing or planned, in countries other than those listed in this footnote.

629 Additional allocation: in Oman, the United Kingdom and Turkey, the band 216 - 235 MHz is also allocated to the radiolocation service on a secondary basis.

631 Different category of service: in Spain and Portugal, the band 223 - 230 MHz is allocated to the fixed service on a permitted basis (see No. **425**). Stations of this service shall not cause harmful interference to, or claim protection from, broadcasting stations of other countries, whether existing or planned, that operate in accordance with the Table.

641 Subject to agreement obtained under the procedure set forth in Article **14**, the bands 235 - 322 MHz and 335.4 - 399.9 MHz may be used by the mobile-satellite service, on condition that stations in this service do not cause harmful interference to those of other services operating or planned to be operated in accordance with the Table.

641A The bands 312 - 315 MHz (Earth-to-space) and 387 - 390 MHz (space-to-Earth) in the mobile-satellite service may also be used by non-geostationary-satellite systems. Such use is subject to the application of the coordination and notification procedures set forth in Resolution 46 (WARC-92).

642 The frequency 243 MHz is the frequency in this band for use by survival craft stations and equipment used for survival purposes.

643 Subject to agreement obtained under the procedure set forth in Article **14**, the band 267 - 272 MHz may be used by administrations for space telemetry in their countries on a primary basis.

644 In making assignments to stations of other services to which the band 322 - 328.6 MHz is allocated, administrations are urged to take all practicable steps to protect the radio astronomy service from

harmful interference. Emissions from space or airborne stations can be particularly serious sources of interference to the radio astronomy service (see Nos. **343** and **344** and Article **36**).

645 Limited to Instrument Landing Systems (glide path).

645A Additional allocation: in Afghanistan, the Federal Republic of Germany, Austria, Belgium, Cyprus, Denmark, Egypt, Spain, France, Greece, Israel, Italy, Japan, Jordan, Malta, Morocco, Monaco, Norway, the Netherlands, Portugal, the United Kingdom, Sweden, Switzerland, Syria and Turkey, the band 328.6 - 335.4 MHz is also allocated to the mobile service on a secondary basis subject to agreement obtained under the procedure set forth in Article **14**. In order to ensure that harmful interference is not caused to stations of the aeronautical radionavigation service, stations of the mobile service shall not be introduced in the band until it is no longer required for the aeronautical radionavigation service by any administration which may be identified in the application of Article **14**.

645B Recognising that the use of the band 399.9 - 400.05 MHz by the fixed and mobile services may cause harmful interference to the radionavigation satellite service, administrations are urged not to authorise such use in application of No.**342**.

646 Emissions shall be confined in a band of ±25 kHz about the standard frequency 400.1 MHz.

647 Additional allocation: in Afghanistan, Saudi Arabia, Bahrain, Bulgaria, Colombia, Costa Rica, Cuba, Egypt, the United Arab Emirates, Ecuador, Hungary, Indonesia, Iran, Iraq, Israel, Jordan, Kuwait, Liberia, Malaysia, Nigeria, Oman, Pakistan, the Philippines, Poland, Qatar, Syria, the German Democratic Republic, Romania, Singapore, Somalia, Sri Lanka, Czechoslovakia, Thailand, the USSR and Yugoslavia, the band 400.05 - 401 MHz is also allocated to the fixed and mobile services on a primary basis.

647A The band 400.15 - 401 MHz is also allocated to the space research service in the space-to-space direction for communications with manned space vehicles. In this application, the space research service will not be regarded as a safety service..

647B The use of the band 400.15 - 401 MHz by the mobile-satellite service is subject to the application of the co-ordination and notification procedures set forth in Resolution **46(WARC-92)**. However, co-ordination of a space station of the mobile-satellite service with respect to terrestrial services is required only if the power flux-density produced by the station exceeds -125 dB(W/m²/4 kHz) at the Earth's surface. The above power flux-density limit shall apply until such time as a competent world administrative radio conference revise it. In making assignments to the space stations in the mobile-satellite service in the above band, administrations shall take all practicable steps to protect the radio astronomy service in the band 406.1 - 410 MHz from harmful interference from unwanted emissions.

649 The use of the band 406 - 406.1 MHz by the mobile-satellite service is limited to low-power satellite emergency position-indicating radiobeacons (see also Articles **38** and **N38**).

649A Any emission capable of causing harmful interference to the authorised uses of the band 406 - 406.1 MHz is prohibited.

650 In making assignments to stations of other services to which the band 406.1 - 410 MHz is allocated, administrations are urged to take all practicable steps to protect the radio astronomy service from harmful interference. Emissions from space or airborne stations can be particularly serious sources of interference to the radio astronomy service (see Nos. **343** and **344** and Article **36**).

651 Different category of service: in Australia, the United States, India, Japan and the United Kingdom, the allocation of the bands 420 - 430 MHz and 440 - 450 MHz to the radiolocation service is on a primary basis (see No. **425**).

651A Use of band 410 - 420 MHz by the space research service is limited to communications within 5 km of an orbiting, manned space vehicle.

653 Additional allocation: in China, India, the German Democratic Republic, the United Kingdom and the USSR, the band 420 - 460 MHz is also allocated to the aeronautical radionavigation service (radio altimeters) on a secondary basis.

654 Different category of service: in France, the allocation of the band 430 - 434 MHz to the amateur service is on a secondary basis (see No. **424**).

655 Different category of service: in Denmark, Libya, Norway and Sweden, the allocation of the bands 430 - 432 MHz and 438 - 440 MHz to the radiolocation service is on a secondary basis (see No. **424**).

656 Alternative allocation: in Denmark, Norway and Sweden, the bands 430 - 432 MHz and 438 - 440 MHz are allocated to the fixed and mobile, except aeronautical mobile, services on a primary basis.

657 Additional allocation: in Finland, Libya and Yugoslavia, the bands 430 - 432 MHz and 438 - 440 MHz are also allocated to the fixed and mobile, except aeronautical mobile, services on a primary basis.

658 Additional allocation: in Afghanistan, Algeria, Saudi Arabia, Bahrain, Bangladesh, Brunei Darussalam, Burkina Faso, Burundi, Egypt, the United Arab Emirates, Ecuador, Ethiopia, Greece, Guinea, India, Indonesia, Iran, Iraq, Israel, Italy Jordan, Kenya, Kuwait, the Lebanon, Libya, Liechtenstein, Malaysia, Malta, Nigeria, Oman, Pakistan, the Philippines, Qatar, Syria, Singapore, Somalia, Switzerland, Tanzania, Thailand, Togo, Turkey and Yemen, the band 430 - 440 MHz is also allocated to the fixed service on a primary basis and the bands 430 - 435 MHz and 438 - 440 MHz are also allocated to the mobile, except aeronautical mobile, service on a primary basis.

659 Additional allocation: in Angola, Bulgaria, Cameroon, the Congo, Gabon, Djibouti, Hungary, Malawi, Mali, Mongolia, Niger, Pakistan, Poland, the German Democratic Republic, People's Rep. of Korea, Romania, Rwanda, Chad, Czechoslovakia and the USSR, the band 430 - 440 MHz is also allocated to the fixed service on a primary basis.

661 In Region 1, except in the countries mentioned in No. **662** the band 433.05 - 434.79 MHz (centre frequency 433.92 MHz) is designated for industrial, scientific and medical (ISM) applications. The use of this frequency band for ISM applications shall be subject to special authorization by the administration concerned, in agreement with other administrations whose radiocommunication services might be affected. In applying this provision, administrations shall have due regard to the latest relevant CCIR Recommendations.

662 In the Federal Republic of Germany, Austria, Liechtenstein, Portugal, Switzerland and Yugoslavia, the band 433.05 - 434.79 MHz (centre frequency 433.92 MHz) is designated for industrial, scientific and medical (ISM) applications. Radiocommunication services of these countries operating within this band must accept harmful interference which may be caused by these applications. ISM equipment operating in this band is subject to the provisions of No. **1815**.

663 Additional allocation: in the French Overseas Departments in Region 2, and India, the band 433.75 - 434.25 MHz is also allocated to the space operation service (Earth-to-space) on a primary basis. In France and Brazil, the band is allocated to the same service on a secondary basis.

664 In the bands 435 - 438 MHz, 1 260 - 1 270 MHz 2 400 - 2450 MHz, 3 400 - 3 410 MHz (in Regions 2 and 3 only) and 5 650 - 5 670 MHz, the amateur-satellite service may operate subject to not causing harmful interference to other services operating in accordance with the Table (see No.**435**). Administrations authorising such use shall ensure that any harmful interference caused by emissions from a station in the amateur-satellite service is immediately eliminated in accordance with the provisions of No. **2741**. The use of the bands 1 260 - 1 270 MHz and 5 650 - 5 670 MHz by the amateur-satellite service is limited to the Earth-to-space direction.

665 Additional allocation: in Austria, the band 438 - 440 MHz is also allocated to the fixed and mobile, except aeronautical mobile, services on a primary basis.

668 Subject to agreement obtained under the procedure set forth in Article **14**, the band 449.75 - 450.25 MHz may be used for the space operation service (Earth-to-space) and the space research service (Earth-to-space).

669 In the maritime mobile service, the frequencies 457.525 MHz, 457.550 MHz, 457.575 MHz, 467.525 MHz, 467.550 MHz and 467.575 MHz may be used by on-board communication stations. The use of these frequencies in territorial waters may be subject to the national regulations of the administration concerned. The characteristics of the equipment used shall conform to those specified in Appendix 20.

671 Earth exploration-satellite service applications, other than the meteorological-satellite service, may also be used in the bands 460 - 470 MHz and 1 690 - 1 710 MHz for space-to-Earth transmissions subject to not causing harmful interference to stations operating in accordance with the Table.

672 Different category of service: in Afghanistan, Bulgaria, China, Cuba, Japan, Mongolia, Poland, Czechoslovakia and the USSR, the allocation of the band 460 - 470 MHz to the meteorological-satellite service (space-to-Earth) is on a primary basis (see No.**425**) and is subject to agreement obtained under the procedure set forth in Article **14**.

677A Additional allocation: in the Federal Republic of Germany, Austria, Belgium, Cyprus, Denmark, Spain, Finland, France, Ireland, Israel, Italy, Libya, Malta, Morocco, Monaco, Norway, the Netherlands, Portugal, the United Kingdom, Sweden, Switzerland, Swaziland, Syria, Tunisia and Turkey, the band 470 - 790 MHz is also allocated on a secondary basis to the land mobile service, intended for applications ancillary to broadcasting. Stations of the land mobile service in the countries mentioned in this footnote, shall not cause harmful interference to existing or planned stations operating in accordance with the Table of Frequency Allocations in countries other than those listed in this footnote.

686 Additional allocation: in the United Kingdom, the band 590 - 598 MHz is also allocated to the aeronautical radionavigation service on a primary basis. All new assignments to stations in the aeronautical radionavigation service, including those transferred from the adjacent bands, shall be subject to co-ordination with the administrations of the following countries: the Federal Republic of

Germany, Belgium, Denmark, Spain, France, Ireland, Luxembourg, Morocco, Norway, and the Netherlands.

689 In Region 1, except in the African Broadcasting Area (see Nos. **400** to **403**), and in Region 3, the band 608 - 614 MHz is also allocated to the radio astronomy service on a secondary basis. In making assignments to stations to other services to which the band is allocated, administrations are urged to take all practical steps to protect the radio astronomy service from harmful interference. Emissions from space or airborne stations can be particularly serious sources of interference to the radio astronomy service (see Nos. **343** and **344** and Article **36**).

693 Within the frequency band 620 - 790 MHz, assignments may be made to television stations using frequency modulation in the broadcasting-satellite service subject to agreement between the administrations concerned and those having services, operating in accordance with the Table, which may be affected (see resolutions **33** and **507**). Such stations shall not produce a power flux-density in excess of the value -129 dB (W/m^2) for angles of arrival less than 20° (see recommendation **705**) within the territories of other countries without the consent of the administrations of those countries.

694 Additional allocation: in Bulgaria, Hungary, Mongolia, Poland, the German Democratic Republic, Romania, Czechoslovakia and the U.S.S.R. the band 645 - 862 MHz is also allocated to the aeronautical radionavigation service on a permitted basis.

695 Alternative allocation: in Spain and France, the band 790 - 830 MHz is allocated to the broadcasting service on a primary basis.

695A Additional allocation: in Austria, Italy, the United Kingdom and Swaziland, the band 790 - 862 MHz is also allocated to the land mobile service on a secondary basis.

696 Alternative allocation: in Greece, Italy, Morocco and Tunisia, the band 790 -838 MHz is allocated to the broadcasting service on a primary basis.

697 Additional allocation: in the Federal Republic of Germany, Burkina Faso, Cameroon, Cote d'Ivoire, Denmark, Egypt, Finland, Israel, Kenya, Libya, Liechtenstein, Monaco, Norway, the Netherlands, Portugal, Sweden, Switzerland and Yugoslavia, the band 790 - 830 MHz and in these same countries and in Spain, France, Malta, the Gabonese Republic and Syria, the band 830 - 862 MHz, are also allocated to the mobile, except aeronautical mobile, service on a primary basis. However, stations of the mobile service in the countries mentioned in connection with each band referred to in this footnote shall not cause harmful interference to, or claim protection from, stations of services operating in accordance with the Table in countries other than those mentioned in connection with the band.

700B Additional allocation: in Belarus, the Russian Federation and Ukraine, the bands 806 - 840 MHz (Earth-to-space) and 856 - 890 MHz (space-to-Earth) are also allocated to the mobile-satellite, except aeronautical mobile-satellite (R) service. The use of these bands by this service shall not cause harmful interference to, or claim protection from, services in other countries operating in accordance with the Table of Frequency Allocations and is subject to special agreements between the administrations concerned.

702 Alternative allocation: in Italy, the band 838 - 854 MHz is allocated to the broadcasting service on a primary basis as from 1 January 1995.

703 In Region 1, in the band 862 - 960 MHz, stations of the broadcasting service shall be operated only in the African Broadcasting Area (see Nos. 400 to 403) excluding Algeria, Egypt, Spain, Libya and Morocco, subject to agreement obtained under the procedure set forth in Article 14.

704 Additional allocation: in Bulgaria, Hungary, Mongolia, Poland, the German Democratic Republic, Romania, Czechoslovakia and the U.S.S.R. the band 862 - 960 MHz is also allocated to the aeronautical radionavigation service on a permitted basis until 1 January 1998. Up to this date, the aeronautical radionavigation service may use this band, subject to agreement obtained under the procedure set forth in Article **14**. After this date, the aeronautical radionavigation service may continue to operate on a secondary basis.

ANNEX B :List of Contributors

AMARC	Int Organisation
CLC TC106	Int Organisation
DVB	Int Organisation
EACEM	Int Organisation
EBU	Int Organisation
EPPA	Int Organisation
ERMES MoU	Int Organisation
ESA	Int Organisation
ESPA	Int Organisation
ETSI RPM	Int Organisation
GSM MoU	Int Organisation
IARU	Int Organisation
NATO	Int Organisation
OECD	Int Organisation
UIC	Int Organisation
Administration	Austria
AKG Acoustics	Austria
Austria Radio Amateur Club	Austria
Grothusen	Austria
Administration	Belgium
Belgium Military Forces	Belgium
EMD	Belgium
Sennheiser	Belgium
Administration	Croatia
Administration	Cyprus
Administration	Czech Republic
Administration	Denmark
Danish Maritime Authority	Denmark
Telecom Denmark	Denmark
Administration	Estonia
Administration	Finland
Nokia	Finland
Vaisala	Finland
Administration	France
ATRAL	France
Beyerdynamic	France
France Telecom	France
MATRA	France
SCV Audio	France
Sennheiser	France
SPER	France
TDF	France
ABIN	Germany
Administration	Germany
ARD	Germany
Beyerdynamic	Germany
Deutsche Forschungsanstalt Fur	Germany
Deutscher Amateur Club	Germany
Deutscher Wetterdienst	Germany
Mannesmann Mobilfunk	Germany
Philips	Germany
Robert Bosch	Germany
Sennheiser	Germany
TELEKOM	Germany
VDEW	Germany
ZVEI	Germany

Administration	Greece
Philippos Nagas	Greece
Administration	Hungary
Administration	Ireland
Telecommunication Systems Ltd	Israel
Administration	Italy
Administration	Netherlands
NOZEMA	Netherlands
Administration	Norway
Norwegian National Military	Norway
Administration	Romania
Administration	Spain
Magnetron	Spain
Administration	Sweden
LLB	Sweden
Luftfartsverket	Sweden
TELIA Network Services	Sweden
Administration	Switzerland
MTEL	Switzerland
Swiss Telecom PTT	Switzerland
Administration	Turkey
Administration	United Kingdom
Association of Service Providers	United Kingdom
Audio Limited	United Kingdom
BBC	United Kingdom
British Railways Telecom	United Kingdom
BT	United Kingdom
Cellnet	United Kingdom
CLMRC	United Kingdom
Dimension Audio	United Kingdom
Europe Airsport	United Kingdom
Home Office	United Kingdom
Independent Radio	United Kingdom
ITV	United Kingdom
JFMG	United Kingdom
National Air Traffic Services	United Kingdom
Philips	United Kingdom
Radio Society of Great Britain	United Kingdom
Royal Automobile Club	United Kingdom
Samson	United Kingdom
Sennheiser	United Kingdom
SHURE	United Kingdom
The Federation of the Electronic Industry	United Kingdom
The Society of London Theatre	United Kingdom
UK Six Meter Group	United Kingdom
Vodafone	United Kingdom

ANNEX C: List of References

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ANNEX D: List of abbreviations

AMARC	World Association of Community Radio Broadcasters
AMPS	Advanced Mobile Phone Service
ARFA	Allied Radio Frequency Agency (within NATO)
ATC	Air Traffic Control
ATV	Amateur TV
BC	Broadcasting service
CAA	Civil Aviation Authorities
CBS	Common Base Station
CENELEC	European Committee for Standardisation and Electrotechnical Standardisation
CEN	European Committee for Standardisation
NJFA	NATO Joint Frequency Agreement
CEPT	European Conference of Postal and Telecommunications Administrations
CERP	European Committee for Postal Regulation
CITEL	Inter-American Telecommunications Conference
CLMRC	UK Civil Land Mobile Radio Committee
CNR	Combat Net Radio
CPG	Conference Preparatory Group (ERC Working Group)
CT	Cordless Telephone
CTR	Common Technical Regulation
DAB	Digital Audio Broadcasting
DCS1800	Digital Cellular System at 1800 MHz
DECT	Digital European Cordless Telecommunications
DME	Distance Measuring Equipment
DSI	Detailed Spectrum Investigation
DSRR	Digital Short Range Radio
DVB	Digital Video Broadcasting
E-GSM	GSM Extension (band)
EACEM	European Association of Consumer Electronics Manufacturers
EBU	European Broadcasting Union
EC	European Commission
ECP	European Common Proposal
ECTEL	European Telecommunications and Professional Electronics Industry
ECTRA	European Committee for Telecommunications Regulatory Affairs
EDTV	Enhanced Definition Television
EEA	European Economic Area
EMC	Electro-Magnetic Compatibility
ENG	Electronic News Gathering
EPIRB	Emergency position indicating radio beacon
EPPA	European Public Paging Association
ERC	European Radiocommunications Committee
ERMES	European Radio Message System
ERO	European Radiocommunications Office
ESA	European Space Agency
ESPA	Association of European Manufacturers of Pocket Communications Systems
ETNO	European Telecommunications Networks Operators Association
ETS	European Telecommunications Standard
ETSI	European Telecommunications Standards Institute
EU	European Union
EUREKA	Industrial and Technical Collaboration in Europe for commercial exploitation
FCB	Frequency Coordination Body Europe(ICAO Regional Office)
FEI	The Federation of the Electronic Industry
FM	Frequency Management (ERC Working Group)
FPLMTS	Future Public Land Mobile Telecommunication Systems
GMDSS	Global Maritime Distress and Safety System
GNSS	Global Navigation Satellite System
GPS	Global Positioning System (using satellites)
GSM	Global System for Mobile Communications
HDTV	High Definition Television

HIPERLAN	High Performance Radio Local Area Network
I-ETS	Interim ETS
IARPA	International Non-Ionizing Radiation Protection Association
IARU	International Amateur Radio Union
ICAO	International Civil Aviation Organization
ILS	Instrument Landing System
IRISAT	Intercontinental Retrieval of Information via Satellite
ISDN	Integrated Services Digital Network
ISM	Industrial, Scientific and Medical
ITU-R	International Telecommunication Union - Radiocommunication Sector
LAN	Local Area Network
LDTV	Low Definition Television
LEO	Low Earth Orbiting (Satellite)
LPD	Low Power Device
LEGBAC	Limited Exploratory Group on Broadcasting and Aeronautical Compatibility
MAC	Multiplex Analogue Components (Colour TV standard)
MFN	Multi Frequency Network
MLS	Microwave Landing System
MOU	Memorandum of Understanding
MRUA	Mobile Radio Users' Association
MSS	Mobile Satellite Service
NATO	North Atlantic Treaty Organisation
NMT	Nordic Mobile Telephone
NOAA	American National Oceanic and Atmospheric Administration
OB	Outside Broadcasting
ONP	Open Network Provision
PABX	Private Automatic Branch Exchange
PAL	Phase Alternate Line (Colour TV standard)
PAMR	Public Access Mobile Radio
PCN	Personal Communications Network
PFD	Power Flux Density
PMR	Professional Mobile Radio
PP-94	1994 ITU Plenipotentiary Conference, Kyoto Japan
PSTN	Public Switched Telecommunications Network
RA	Radio Assembly
RDS	Radio Data Service
RES	Radio Equipment and Systems (ETSI Technical Committee)
RLAN	Radio Local Area Network
RR	Radio Regulatory (ERC Working Group)
S-DAB	Satellite DAB
SAB	Service Ancillary to Broadcasting
SDTV	Standard Definition Television
SE	Spectrum Engineering (ERC Working Group)
SECAM	Séquentiel Couleur à Mémoire (Colour TV standard)
SFN	Single Frequency Network
SNG	Satellite News Gathering
SYLEDIS	Radio positioning system
T-DAB	Terrestrial DAB
TACS	Total Access Communications System
TBR	Common Technical Basis for Regulation
TDMA	Time Division Multiple Access
TETRA	Trans European Trunked Radio
TFTS	Terrestrial Flight Telecommunications System
UHF	Ultra High Frequency (300 MHz - 3 GHz)
UIC	International Union of Railways
UMTS	Universal Mobile Telecommunications System
VHF	Very High Frequency (30 - 300 MHz)
VOR	VHF Omnidirectional Radio Range
VSAT	Very Small Aperture Terminal
WARC-92	World Administrative Radio Conference 1992 in Spain

WLL	Wireless Local Loop
WRC	World Radio Conference

ANNEX E: Structure of ERC

ANNEX F: MECHANISM FOR ERC DECISIONS

1. Introduction

Decisions should be the outcome of a decision making process on matters of significant harmonisation in the radiocommunications regulatory field, within the context of a long term ERC strategy and policy.

There are two elements to the process of producing Decisions: adoption and implementation.

2. Adoption

The ERC shall decide whether a new item of work should lead to a Decision or other ERC output, before work is commenced.

The appropriate Working Group shall produce a draft text for consideration by an ERC meeting. The final draft shall be distributed to ERC Members at least 2 weeks prior to the meeting at which it will be considered. An indication of support for, and any reservations on, the proposal should be provided.

The ERC shall adopt the draft Decision preferably by consensus or, exceptionally, to avoid weakening of the text, by voting on the basis of one member one vote and a simple majority. Proxy voting is permitted according to Article 14 of the Rules of Procedure.

The final text of the Decision shall be included as an annex to the Report of the Meeting at which it is agreed.

3. Implementation.

ERC Members should write to the ERC Chairman within 2 months of the approval of the Decision indicating whether they commit themselves to implement its terms. A copy of the letter should be sent to the ERO. The Decision is then given a first publication indicating the Members who have committed themselves to implement its terms.

Following the subsequent ERC meeting, the Decision is given a second publication updating the list of Members that have committed themselves to implement its terms.

Members may commit themselves to Decisions at any time.

ANNEX G: List of CEPT ERC Decisions and Recommendations relevant to the frequency band 29.7 - 960 MHz

CEPT/ERC/DECISIONS

(93)01	March 1993	Decision on the frequency bands to be designated for the coordinated introduction of Digital Short-Range Radio (DSRR)
(94)01	October 1994	Decision on the frequency bands to be designated for the coordinated introduction of GSM pan-European digital communications system
(94)02	October 1994	Decision on the frequency bands to be designated for the coordinated introduction of European Radio Messaging System (ERMES)

CEPT /ERC Recommendations

T/R No	Title
01-01	Recognition of 'Certificate of acceptance' for equipment capable of producing interference
01-04	Use of low power devices (LPD) using integral antennas and operating in harmonised frequency bands
02-01	Planning and coordination of land mobile (and other) services operating in the band 47 - 68 MHz
01-05	Transposition of national standards to enable introduction of European standards.
02-02	Harmonised frequency band for the emergency services
20-01	Operation of the European radiopaging service
20-03	Low power telecommand and telemetry equipment operating on collective frequencies in ISM bands
20-04	Low power narrow band telecommand and telemetry equipment for use outside the ISM bands
20-05	Low power radio paging systems
20-06	Transmitters and receivers for low power cordless microphones
20-08	Frequency planning and frequency coordination for the GSM system
20-09	PR 27 equipment intended to provide short range radio communication in the 27 MHz band
20-10	Digital short-range radio (DSRR) intended to provide short-range voice and/or data radiocommunication in the frequency bands 933 - 935 / 888 - 890 MHz
21-06	Conditions under which land mobile radio equipment may be carried but without being operated during short journeys and stays within CEPT countries
21-07	Border crossing and use of mobile transmitter-receivers in CEPT members countries 1989
21-08	Type approval procedures and free circulation for GSM mobile stations
22-01	Frequencies likely to be allocated to international railways

22-05	Frequencies for mobile digital trunked radio systems
24-01	Specifications of equipment for use in the land mobile service
24-03	Radio characteristics of cordless telephones
25-03	Coordination of frequencies for the land mobile service in the 80, 160 and 460 MHz bands and the methods to be used for assessing interference
25-05	Planning and coordination of the land mobile service operating in the bands 174 - 230 MHz (TV Band III)
25-06	Planning parameters to assist the efficient and effective utilisation of shared frequency bands which are allocate to the broadcasting service(television) and the land mobile service, using assignments which overlap a television channel (Television bands I and III only)
25-07	Frequency coordination for the European radio message system (ERMES)
25-08	Coordination of frequencies in the land mobile service in the range 29.7 - 960 MHz
25-09	Designation of frequencies in the 900 MHz band for railway purposes
31-03	Harmonized examination procedures for the General Operator's Certificate (GOC) and the Restricted OC (ROC)
32-02	Frequencies to be used by on-board communication stations
34-01	Specifications for maritime mobile radio equipment
41-01	Interim Type Approval, Free Circulation and use of airborne terminal equipment of the terrestrial flight telephone system (TFTS)
50-02	Concerning the introduction of terrestrial digital audio broadcasting (T-DAB)
51-01	Measures to be taken to prevent operation of broadcasting stations on board of ships or aircraft outside national territorial limits
52-02	Introduction of terrestrial digital audio broadcasting (T-DAB)
61-01	CEPT Radio Amateur Licence
61-02	Harmonised amateur radio examination certificate
70-01	Possible reduction in certain types of mutual interference between the broadcasting service and the mobile service
70-02	Measures required to prevent unlawful use of radio equipment
71-01	Economy in the use of the frequency spectrum
71-03	Procedures for type testing and approval for radio equipment intended for non-public systems
72-01	Allocation of frequencies in the frequency bands between 29.7-960 MHz
75-02	Use of frequencies in the band 862 - 960 MHz by the mobile except aeronautical mobile service
75-03	Utilisation of frequencies abroad for various applications

75-04 Exchange of information between administrations and between administrations and international organisations relating to space services.

Should you wish to purchase these or other CEPT Documents, please contact :

CEPT LIAISON OFFICE
P.O.Box
CH-3001 Bern
Switzerland

Telefax : + 41 31 338 20 78

or

EUROPEAN RADIOCOMMUNICATIONS OFFICE
Holsteinsgade 63
DK-2100 Copenhagen
Denmark
Telephone : + 45 35432442
Telefax : + 45 35433514

for the complete Publications Catalogue.

ANNEX H: SAFETY LIMITS FOR ELECTRICAL AND MAGNETIC FIELD-STRENGTHS

ANNEX I: RELEVANT DSI PHASE I RECOMMENDATIONS

9.3 Block Allocations

> It is therefore recommended that the provision of large block allocations to individual users be kept to a minimum by all CEPT administrations. Studies should be initiated to ascertain whether perceived future spectrum requirements, especially in the range 3.4 - 17.7 GHz, could be accommodated more easily and efficiently if block allocations were to gradually cease.

9.6 More Common Use of the Spectrum by Defence and Civil Systems

> It is therefore recommended that European civil and defence frequency managers in CEPT countries explore opportunities for more common use of frequencies by civil and military systems where defence capabilities are not jeopardised by such use. It is further recommended that the ERC initiate a study on the way bands below 20 GHz used for radiodetermination activities are exploited and managed in CEPT countries.
>
> It is additionally recommended that where allocations have in the future to be used in common by civil and defence authorities the ERC and CEPT administrations should support a review of how such splits should be implemented to the benefit of all spectrum users.

9.7 Defence Community

> It is recommended that the ERC and CEPT administrations in conjunction with European military authorities and organisations make every effort to establish within CEPT a mechanism whereby joint civil and military spectrum issues can be discussed.

9.8 More Research to Improve Efficiency of Spectrum Usage

> It is recommended that the ERC and CEPT administrations be encouraged to co-ordinate, enhance and develop research programmes aimed at enabling the radio spectrum to be used more intensively and efficiently.

9.10 Liberalisation of CEPT Administrations' Policy and Satellite Networks

It is recommended that CEPT administrations in following closely the liberalisation proposed by the EC collectively develop strategic plans to make spectrum available for telecommunication satellite systems including VSAT systems in accordance with market demands.

9.12 Enhanced Databases and improved Computer Assistance

It is therefore recommended that the ERC, CEPT administrations and other organisations responsible for spectrum management should be encouraged to use advanced and integrated computer-assisted management techniques to enable the radio spectrum to support the maximum number of systems. It is further recommended that, subject to IPR constraints, planning and spectrum management software should be developed on a European basis to the benefit of all CEPT administrations.

9.14 National DSIs and Market Research

It is therefore recommended that DSIs be conducted by CEPT administrations on a national basis and that market research studies be conducted prior to spectrum being allocated for major new radiocommunications developments.

9.15 Co-operation with ETSI and the EC

It is recommended that the CEPT administrations be active and cooperate effectively in ETSI. The ERC is additionally recommended to take initiatives, in co-operation with particularly ETSI and the EC, to develop common strategies for an efficient future use of the spectrum, while taking account of radio regulatory matters in general.

ANNEX J: EXAMPLE OF FREQUENCY USE OF CORDLESS MICROPHONES IN A LARGE PRODUCTION (see section 10.10.3)

PINK FLOYD WORLD TOUR 1994

Frequencies in MHz

IN-EAR SYSTEMS

1A	516.950
1B	518.950
2A	523.350
2B	524.550
3A	529.350
3B	530.550
4A	594.950
4B	596.150
5A	601.350
5B	602.550
69A	854.900
69B	855.275
69C	855.900
69D	860.400
69E	860.900
69F	861.750

DIVERSITY MICROPHONES

177.600
190.600
196.600
202.200

GUITAR SYSTEMS (T.R. & BASS)

CHANNEL0	174.600
CHANNEL1	177.600
CHANNEL2	181.600
CHANNEL3	183.600
CHANNEL4	186.600
CHANNEL5	190.600
CHANNEL6	192.600
CHANNEL7	195.600
CHANNEL8	196.600
CHANNEL9	199.600

Hand portable

CHANNEL1	462.43750
CHANNEL2	461.28750
CHANNEL3	461.73750
CHANNEL4	461.98750
CHANNEL5	464.98750
CHANNEL6	463.21250
CHANNEL7	463.28750
CHANNEL8	463.28750
CHANNEL9	463.38750

ANNEX K: Format for submissions to the public consultation process

This consultation process is intended to obtain the views, opinions and concerns of the general public and not the radio regulatory administrations of CEPT member countries who are invited to submit their views directly to the appropriate constituent bodies of the ERC.

Contributions to the Public Consultation process are requested to take account of the following points:

1. It would be preferred if all submissions and comments received can be exposed to public inspection and comment.

2. Whilst it is accepted that a party may want to protect commercially sensitive material, submitters should bear in mind that comments tested by public exposure have greater strength than those based on commercially sensitive material which is limited to ERO's analysis only.

3. Any commercially sensitive material should therefore be identified and kept separate from the main body of comments.

4. ERO would prefer comments to be succinct and focused on the relevant issues under discussion.

5. If possible the text should be provided on diskette, in which case any type of word processor may be used, but Microsoft Word for Windows is preferred.

6. Format

ERO would prefer comments to utilise the following format:

- be typed in a machine readable font (preferably 12 point) in one and a half spacing;
- be presented using A4 size paper, printed on one side only;
- have 3 cm margins down both sides and on top and bottom of each page;
- be page numbered and have paragraph and sub-paragraph numbers;
- make maximum use of headings and sub-headings;
- be submitted unbound so that they may be readily photocopied and machine read.

7. Comments and submissions should be sent to

European Radiocommunications Office
Holsteinsgade 63
DK-2100 Copenhagen
Denmark

to preferably arrive not later than 29 September 1995.