CEPT Report 014

Report from CEPT to the European Commission in response to the Mandate to:

Develop a strategy to improve the effectiveness and flexibility of spectrum availability for Short Range Devices (SRDs)

Final Report July 2006 by the:

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

1. Executive Summary

CEPT has produced this report in order to fulfil a Mandate from the European Commission to develop a strategy to improve the effectiveness and flexibility of spectrum designation for Short Range Devices. This Mandate was aimed at strengthening the Internal Market for generally authorised radio communications products in order to provide legal certainty for Class 1 products but also to improve access to spectrum for innovative products. In doing this, CEPT has borne in mind the following two key points–

- That the CEPT response to the first SRD Mandate[1] concluded that, when developing new products, manufacturers should use existing frequency bands identified for SRDs before requesting new allocations of valuable spectrum.
- That there is growing interest in Europe for using market mechanisms for facilitating spectrum access.

The report therefore covers the possibility of making access to existing SRD spectrum less restrictive by proposing that CEPT considers the removal of as many of the national barriers within existing SRD designations as possible whilst ensuring the protection of the radio services. The report also assess the principle of market mechanisms as applied to SRDs and concludes that, while the opportunities for applying market mechanisms to SRD are limited, it has to be recognised that spectrum has a value and its value to other possible future users may be affected by the presence of a SRD designation. This needs to be taken into account in decisions in making new spectrum designations to SRDs and the report contains detailed proposals on how this can be done.

One of the points that emerged during the production of the report is the varied nature of the industry. The term "SRD Industry" has been used throughout this report but it needs to be noted that it is not just one clearly identifiable industry but a large number of sub-industries producing a very wide range of products and all operating under the general SRD title. These range from control sensors in a large commercial manufacturing process to implantable medical devices and down to toys and garage door openers. These all have different characteristics in terms of cost, bandwidth, technical sophistication etc. Because of the portable nature of many of these devices, some of which are integrated into consumer products which are sold in the expectation that national frontiers will not form a barrier to use, the need for cross-border transportability is greater than for almost any other area of radio use.

Another point that emerged is the difficulty in determining the size of the industry because of the lack of on-going statistics collected on a Europe-wide basis. It was felt that this needed to be rectified if the true value of the industry, and its contribution to the European GDP, is to be properly assessed.

The increasing use of SRDs to provide radio solutions in terms of greater mobility, ease of installation and reduced cost has led to a greater density of use and the increased potential for mutual interference. The problems that this might be expected to cause have largely not occurred due to the low power nature of these devices and the use of modern techniques such as duty cycles, carrier sensing systems etc. This supports the current philosophy that SRDs

[1] Report from CEPT to the European Commission in response to the Mandate to Short Range Devices Radio Spectrum Harmonisation, approved by the ECC on 12 November 2004.

should be exempt from licensing unless there are justifiable reasons for imposing this restriction.

This report is structured so that the Conclusions and Recommendations can be found in Section 5; a description of the many sub-sectors of the industry is at Section 6; Economic considerations can be found at Section 7; how SRDs are regulated at the moment is at Section 8 and proposals for the future SRD Regulatory Environment is at Section 9 and best practices applied outside ITU Region 1 is at Section 10. The report also contains Annexes providing technical information relevant to SRDs, new technologies and notes concerning the possibility of accessing broadcast bands.

Lastly, for ease of reference, the term “radio services” has been used in this Report to distinguish between SRDs and radio services as defined in Article 1 Section III of the ITU Radio Regulations.

2. Table of contents

3. Introduction

This draft report has been developed by the European Conference of Postal and Telecommunications Administrations (CEPT) in response to the second EC Mandate given to CEPT to develop a strategy to improve the effectiveness and flexibility of spectrum availability for Short Range Devices (SRDs) pursuant to Article 4 of the Radio Spectrum Decision to analyse–

- if the conditions of use for short-range devices are sufficiently permissive,
- the harmonisation of European regulations with least restrictive and justified limits necessary to avoid harmful interference to radiocommunication services,
- the possibility of systematically allowing operations below a common power threshold,
- the future evolution of EU demand for SRD spectrum and consider the most appropriate way to be able to provide the required resources in a timely fashion,
- the speed and effectiveness of procedures to grant access to SRD spectrum resources on a EU level;

The report has been developed within FM Project Team 43 with contributions from administrations, ETSI members and industry. The draft outline of the report was presented to the WG FM meeting in September 2005 and an interim report was adopted by the ECC at its meeting in Portugal on 24-28 October 2005 in accordance with the timescales of the Mandate.

Recently, separate Mandates relating to Short Range Devices have been issued by EC to CEPT regarding 5 GHz Radio LANs, Short Range Radars and Ultra Wide Band. Relevant CEPT Reports in response to these Mandates have already been submitted and accepted by the European Commission (EC).

The current second Mandate for SRDs is expected to cover Short Range Devices in general with the objective of covering issues such as frequency harmonisation, legal certainty and the support of long term pro-innovation policies.

This report assesses the progress that has been made so far in providing harmonised frequency bands for SRDs. It also considers the principle that should be applied in the consideration of new frequency bands for SRDs. These take into account the relative benefits and costs, economic and otherwise, of agreeing new harmonised SRD bands. They should encourage innovation and research whilst supporting the generic principles of maximising the benefits derived from spectrum, technology neutrality and proportionality.

One of the points made clear by industry is the value it places on CEPT ERC Recommendation 70-03 (ERC/REC 70-03) as a reference document and guide to the spectrum available for SRD use within CEPT countries. CEPT recognises that SRD regulation should be on the basis of the minimum number of constraints and maximum flexibility and seeks to improve ERC/REC 70-03 to reflect this. For example, the current ERC/REC 70-03 contains an Appendix listing national restrictions which, in the interests of harmonisation, CEPT Administrations continually strive to minimise.

4. Background

4.1 Response to First EC Mandate

A Mandate, to analyse the further harmonisation of frequency bands in use for Short Range Devices (SRDs) was issued to CEPT by the EC in March 2004. A Report in response to this first Mandate was developed within the Short Range Device Maintenance Group (SRD/MG).

The Electronic Communications Committee (ECC) at its meeting in Brugge on 8-12 November 2004 considered the draft final report from CEPT in response to this first EC Mandate on Short Range Devices (SRDs). While in general the requirements of the mandate had been met, it was recognised that it had not been possible to develop some of the forward looking elements in as much detail as would have been preferable, due to time constraints. At that time the ECC decided that it would be better to conclude on the Mandate and to ask WGFM to develop a strategy for the longer term development of SRDs. Terms of Reference for a new project team, FM PT 43, were drafted and agreed. ETSI members and trade associations offered to contribute to the work in WGFM. The EC decided to support this work by issuing a new Mandate to cover the forward-looking elements of the original Mandate in further detail.

The final CEPT Report in response to the first Mandate was sent to the Commission on 15 November 2004 and discussed at RSC#10 on 8 December 2004. The Member States and the EC welcomed the Report, in particular the analysis of the current status of spectrum harmonisation for SRDs, which provided a clear baseline to undertake actions aimed at strengthening the legal basis of the harmonisation process and the internal market for SRDs in the EU.

However, both the Radio Spectrum Committee (RSC) and CEPT recognised that further work was necessary to properly address the more forward-looking elements of the Mandate, namely identifying a long-term strategy and a common approach to improve the effectiveness and flexibility of SRD spectrum availability.

4.2 Second EC Mandate

At the RSC meeting held on 10 March 2005, the EC presented a document on a proposed Decision on SRD harmonisation. The EC explained that its intention was to draft a Decision based on the results of the first Mandate to CEPT in order to support the internal market for SRD equipment. It explained that it intended that the Decision should provide legal certainty on the availability and conditions of use of specific frequency bands.

At the same meeting, the EC also agreed to issue a second Mandate to CEPT to focus on the development of a forward-looking strategy for SRDs (see Annex 1). Although this request had been included within the scope of the first Mandate, it was commonly agreed that most future-looking aspects were not fully covered in the CEPT Report in response to that Mandate.

4.2.1 Specific objectives of Second EC Mandate

Under the second Mandate on SRDs, the EC seeks to strengthen the internal market for SRDs by exploring methods and regulatory mechanisms to:

- promote more permissive conditions of use for short-range devices, (including inductive applications), harmonising European regulations on the least restrictive and justified limitations necessary to avoid harmful interference to radio Services, and exploring the possibility for systematically allowing operations below a common power threshold;

- anticipate the future evolution of EU demand for SRD spectrum and consider the most appropriate way to be able to provide the required resources in a timely fashion;

- increase the speed and effectiveness of procedures to grant access to SRD spectrum resources on a EU level.

5. Conclusions and Recommendations

The conclusions and recommendations of this Report are as follows:

5.1 Conclusions:

i. That greater public awareness of the benefits that radio provides and the wider availability of chipsets at reduced cost are increasing the demand for spectrum for both radio services and SRDs.

ii. That SRDs cover a very wide range of applications that provide real economic value to industry and to EU citizens in terms of efficiency and quality of life.

iii. That the increasing demand for spectrum for radio services can affect the availability of spectrum for SRDs.

iv. That there is a growing interest in the use of market mechanisms for spectrum management by a number of Administrations in Europe.

v. The opportunities for applying market mechanisms in the designation of spectrum for the SRD industry are limited.

vi. The presence of SRDs may have an impact on the use of the radio services in shared spectrum.

vii. The contribution of SRDs to GDP is difficult to evaluate due to the indirect nature of the benefits derived from SRDs and the lack of ongoing market statistics as a consequence of the diversity of the market.

viii. That a balanced decision should be made by administrations between the demands for spectrum for radio services and for SRDs so as to secure optimal use of the radio spectrum.

ix. That the low emitted power levels typically employed by SRDs results in a high degree of sharing and spectrum use. This could be further enhanced by the application of new technologies identified in this Report to reduce the likelihood of interference.

x. That, in many situations, the potential interference between co-located wireless devices is under the control of the user. Therefore a minimum separation distance does not always have to be regulated.

xi. That the SRD industry greatly values ERC Recommendation 70-03 as a vital regulatory reference document and as a guide to the spectrum available for SRD use within CEPT countries. However, as product lifetimes decrease, industry requires the speedier adoption of all the regulatory parameters in the Recommendation by all Administrations without national restrictions.

xii. That the vast majority of SRDs are covered by generic Annexes of ERC/REC 70-03. However, there are also specific Annexes which deal with particular applications.

xiii. Based on the market predictions in this Report there is a probable need for additional spectrum for SRDs in the future, especially in the UHF band.

xiv. That the increasing use of SRDs in nomadic applications requires global spectrum identification or defined tuning ranges, where possible.

xv. The definition of certain receiver parameters may result in the more efficient use of the spectrum.

5.2 Recommendations:

i. That CEPT ensures that only the minimum regulations are specified in Recommendation 70-03 and, where appropriate, the application-specific constraints to spectrum use are removed.

ii. That Administrations continue to remove as many national constraints as possible and by indicating timetables for implementation.

iii. That CEPT ensures that the principles of application and technology neutrality are pursued wherever possible in both changes to the existing regulatory environment and in the assessment of requests for new spectrum.

iv. The CEPT should investigate the possibility of developing limits below which a new class of generic Ultra Low Power (ULP) SRDs need not be subject to the usual regulatory arrangements such as channelisation, duty cycles, etc. that would ensure the protection of all radio services.

v. That additional spectrum should only be made available to SRDs on the basis of a clear and demonstrable need. Any analysis of the case for new spectrum should include a valid reason why existing SRD spectrum is unsuitable and must fully take into account the impact on radio services.

vi. That CEPT should carry out periodical assessments of trends and future demand for spectrum for SRDs as necessary.

vii. That CEPT should investigate the feasibility of using frequencies above or around 40 GHz for some SRD applications.

viii. That the use of techniques that facilitates greater sharing between SRD systems and between SRD systems and radio services be further encouraged.

ix. That CEPT should continue to assess the prospects for global harmonisation. This should be by continued involvement in the work on ITU-R Recommendation SM.1538-1, by investigating the merits of placing SRDs on the Agenda of a future ITU World Radio Conference and the cooperation of European standardisation organisations and those outside Europe such as IEEE 802.

x. That for R&TTE Class 2 SRDs the merits of a “one-stop, on-line notification” procedure should be investigated. Manufacturers should be informed of national restrictions, where applicable, including national power limits, special conditions (e.g. indoor/outdoor use).

6. Short Range Device Industry: Market and Technology Trends

6.1 Introduction

The Short Range Device market is not a single entity because it is comprised of a number of markets for a wide range of diverse applications.

Unlike clearly defined sectors such as "GSM", SRDs vary enormously in their applications and technical characteristics, e.g. frequency, power, bandwidth, modulation techniques etc. It is therefore essential to review each SRD market sector in the light of its particular needs before considering the implications.

In addition, because of the unlicensed nature of the SRD Industry, reliable market statistics are very difficult to collect. What follows, therefore, is the best result available from questionnaires circulated to the Low Power Radio Association (LPRA), European Information, Communications and Consumer Electronics Technology Industry Associations (EICTA), ISAD, other trade associations and discussions with individual SRD manufacturers and users. A short description of the different SRD markets is given followed by details, where available, of relevant market statistics.

6.1.1 Radio Frequency Identification Devices (RFID)

The current frequency allocations for RFID are mainly in the 120-148.5 kHz, 13.56 MHz, 865-868 MHz and 2.4 GHz frequency bands. The Low Frequency to Ultra High Frequency bands attract particular attention, with focus on the UHF band because of its combination of long reading range and global adoption and because the market commitment to this band is likely to stimulate a growth in RFID in general.

Since logistic and transport/automotive[2] applications tags are attached to cargo items, it follows that global commonality of usable spectrum is desirable. As tags can be manufactured to cover a 100 MHz operating range, it is possible for the same tags to be read at different frequencies in the three Regions. For example in Europe interrogators operate within the band 865 – 868 MHz while in the USA they operate at 902-928 MHz. The ability of tags to operate globally is an attractive proposition and this has already persuaded major users, such as supermarkets and retailers to commit themselves to its adoption. The entry of such mass users will stimulate rapid expansion of installed systems.

In addition to logistic applications there are a number of other rapidly growing areas of use. These include mass transportation, tagging of live-stock, vehicle security systems, access control into buildings and many more. A further considerable potential application is the tagging of airline baggage. These applications operate predominantly in either the inductive communication band below 148 kHz or at 13.56 MHz or at UHF.

[2] Applications in the transport/automotive sector fall into two categories. One use relates to identification of both trucks and railway wagons and their contents for logistic purposes. The second use concerns tracing the individual components of a vehicle such as its engine, gearbox, alternator on manufacturing assembly lines etc.

Market data (EEA Zone only)

Figure 1 below shows the market predictions for logistic applications for UHF passive tags until 2012 and Figure 2 shows the market predictions for the growth of sites to be installed with RFID tag/interrogator systems.

Figure 1: Projected growth of UHF RFID tags between 2006 and 2012

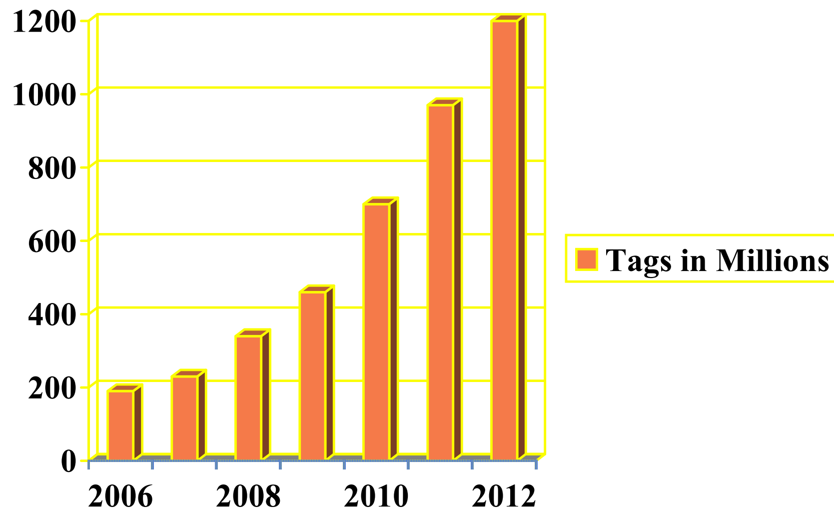
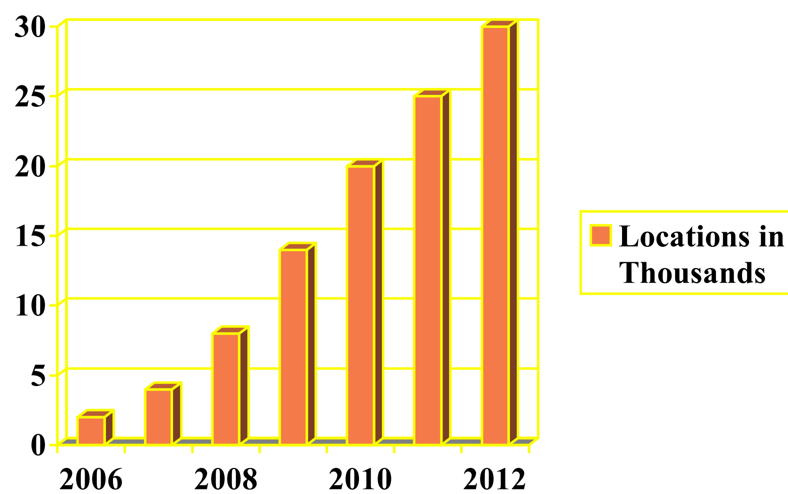


Figure 2: Projected growth of sites to be installed with UHF RFID tag/interrogator systems between 2006 and 2012.



The sheer number of systems anticipated will almost inevitably cause hotspots of interference. Although the range of the tags returning signals to their attendant interrogators is short (1-2 m) the illuminating power of the interrogators (up to 2 W) has the potential to cause interference over wide areas. The proper function of the RFID systems within a given area and with a large number of installed systems seems feasible if strict codes of practice for use and installation are followed. This is clearly recognised by the RFID industry which is currently addressing the problems in conjunction with ETSI.

The anticipated rapid increase in the number of tagged items will also drive demand for increased channel bandwidth (to 500 kHz) to maintain system response time by means of increased data rates.

RFID will therefore be a major exploiter of the UHF band and may well create problems for other band users. In recognition of this, the RFID industry has already adopted spectrally efficient techniques (Listen Before Talk/Adaptive Frequency Agility (LBT/AFA)) to mitigate the anticipated problems. However the projected rapid growth will require additional spectrum (preferably as close as possible in frequency to the existing allocation) to meet market needs.

6.1.2 Meter Reading

Until recently, with a few exceptions, remote utility metering has been confined to trial sites of few hundreds/thousands of units. A combination of the introduction of very low cost chipset based transceivers and batteries offering 5 or more year operating life have produced the market conditions needed to stimulate wide scale installation.

Two types of meter reading systems are emerging namely, fixed infrastructure and 'drive-bys'. Both require reliable operating ranges of 100 – 400 m, good building structure penetration characteristics and low battery power usage. Hence demand for this application is concentrated in the VHF range (100 – 220 MHz). Spectrum for these systems has already been designated in the UK and more recently within the re-farmed European Radio Messaging System (ERMES) band, though the available spectrum is limited and systems are also available operating at 868 – 870 MHz. Market feedback indicates that the slowness of some Administrations in adopting the refarmed ERMES channels allocated to meter reading is causing more pressure on the 863 – 870 MHz band. Because of the long term deployment and life expectation of metering systems certainty of spectrum availability is extremely important if widescale installation is to occur.

Drive-by systems (commonly used in condominiums) comprise a vehicle-mounted interrogator that activates receiving stations within a certain area to allow a data dump. The system operating pattern is such that relatively low (9000 – 19200 baud) data rates are adequate to download from 50 – 500 'outstation' sites over a minute or so, once or twice daily. The overall duty cycle is thus low. As externally mounted omni directional antennas are generally employed in this industry, the potential for interference with other systems is high, particularly for 'drive-bys'.

Market data & spectrum implications

If Utilities adopt remote meter reading, the market for these systems could potentially be huge, perhaps as many as 200 million 'outstation' units in mainland Europe. Market pressure on companies to produce multi – utility systems is therefore intense. To maintain low duty cycles and because of range limitations, hierarchical data retrieval architecture will be needed to achieve the required coverage within fixed architecture systems. This inherently demands a number of operating channels within the chosen band to avoid interference between different networks operated by competing service providers.

Systems for concentrating data will then require different operating frequencies and much higher bandwidth to achieve the required data transmission rates. This may exacerbate inter-SRD interference probability; though concentrators using GSM or other trunk services to download data to remote collection centres could avoid this (see Section 6.1.15.)

6.1.3 Automotive Applications

The automotive industry is likely to be one of the greatest users of radio technology, in particular SRDs, in the future.

Present and future applications of radio to vehicles, in the "intelligent vehicle concept", include active and passive safety, driver assistance, communication, navigation, traffic information, services, e-Call, sensors, short range radar (SRR), adaptive cruise control (ACC), RFID for commercial transport, remote key entry, tyre pressure monitoring, in – car communication, driver condition and passenger surveillance, sensor signal controls and remote tolling.

Market data

The automotive industry anticipates a future in which electronic systems will account for 20 – 30% of the total vehicle value. Additionally the infrastructure to provide associated services will play a vital role. Currently, the automotive industry produces around 8.5% of the EU government revenue. This is expected to increase with the introduction of further road tolling and other mileage related charges and new SRD applications.

Thus, if electronic systems evolve to the expected 20/30 % of vehicle value, of which a large part is wireless devices, the influence of the automotive industry on the variety and density of SRDs cannot be overstated. Further, because vehicles are mobile and can cross international borders, pressure from this industry for a global approach to spectrum is inevitable.

Safety critical considerations are cited by this industry as a reason to call for protected spectrum, free from interference for some systems. This is incompatible with the current basis on which SRD spectrum is designated and solutions should be investigated on a case by case basis. In this regard, the "light licensing" concept should be investigated.

Today, in the infancy of automotive use of wireless techniques, use is already made of the LF range, 433 MHz, 868 – 870 MHz, 2.4 GHz SRD bands, with communication systems "in the pipeline" at 5.8 GHz with additionally, vehicle radar equipment operated at 24 GHz, 77 GHz. Future automotive applications are planned for 63-65 GHz and 79 GHz. The 140 GHz band is also foreseen for future, longer term applications.

6.1.4 Asset Tracking and Tracing

Although Asset Tracking and Tracing systems have been available for some years, their overall adoption has been low and interference has not been a major cause of concern. The recent designation of asset tracking and tracing to the low power portion of the band 169.4 - 169.8125 MHz, with a commensurate high power 'interrogator' in the upper part of this band, on a harmonised basis may change this. There is enormous potential in this market since these devices can be used for human, animal and product tracking applications.

Although the duty cycle for an asset tracking transponder is very low (<0.01%) the sheer volume of terminals anticipated if the market takes off will inevitably cause service availability restrictions for other users of the band and for competing asset tracking operators. Coverage and penetration requirements, together with the mobility of the monitored subjects mean that this type of system requires its own study to assess its potential for interference to other SRD equipment. For the system to be effective across national borders mobility requires that a harmonised approach to their regulation be taken.

Market data
At present, no reliable overall market data has been located though information has been obtained indicating that individual system sizes of over 2 million units are in the planning stage.

6.1.5 Wireless Applications in Healthcare

a) Wireless data transfer between a patient's implants, sensors, etc and remote diagnostic, programming and monitoring equipment–within a hospital or other dedicated care-giving facilities.
b) On-body and in-body wireless monitoring of conditions including heart rate, blood pressure and arterial pressure. This list of applications is increasing daily.
c) Methods by which 'on body and in-body' monitored conditions may be reliably transmitted to local data recording facilities and distant remote monitoring centres.

There is a linkage between SRD 'on body and on-body' systems and Accident & Emergency facilities using non-SRD applications including Private Mobile Radio (PMR),GSM/UMTS installations that will permit rapid deployment of assistance for emergency conditions detected by the medical systems

A harmonised global approach for these applications is critical due to the inherent mobility of people. The absence of global approach is acting as a barrier to technology and impeding the use of these devices between ITU Regions. It may be that some of the data transmission needs (broadband data transfer, real time video, etc.) can be supplied by existing international services (WCDMA, CDMA, 3G, GSM etc). Currently there is a growing list of machine-to-machine systems being marketed that are capable of combining narrowband and wideband data transfer with SRD functionality. This cross border problem for medical wireless systems like Active Implantable Medical Devices/Ultra Low Power Active Medical Implants (AIMD/ULP-AMI) has to be solved urgently. Good examples are the remote controlled infusion pumps, operating in the band 902 -920 MHz which are allowed to operate in North America and Australia /New Zealand. These cannot be operated in the EEA because the band is extensively used for cellular telephony and not available for SRD.

Market data
Currently there are some 3 million AIMD/ULP-AMI devices in use within the European Economic Area.

The European market for on-body monitors (mainly using ULP technology) and for which compatibility between vendors is required could be as high as 10% of the population, approximately 50 million devices to be installed over the next 10 years.

Although large, this market will be greatly exceeded by new technologies just emerging. For example, glucose sensors for controlling diabetes are becoming available with a market potential of 170 million individuals worldwide with 15 to 20 million in the European market alone. These numbers are expected to increase dramatically due to the rising incidence of diabetes worldwide.

6.1.6 Alarms

The alarms industry is very diverse. Requirements for the Industrial/Commercial segment of the alarm market (high risk) and the domestic market (low risk) differ greatly.

Since inception, take up of this wireless option (outside process and factory/plant monitoring) has been surprisingly low, though it is now expanding very rapidly. Principal reasons for this lack of adoption have been cost, battery life and low interest from insurers. Advantages to installers have been speed of installation and the fact that a wired infrastructure is not necessary. Finally some standards organisations have made it difficult to compare the performance needs of wired with wireless alarm systems.

Factors such as the

a) availability of low cost chipset based transceivers and
b) long life batteries

have radically altered this position and have been further aided by the near certainty of correct operation without the need for costly wireless path surveys.

The preferred spectrum for the alarms market is UHF but there is also a strong interest in VHF due to the better penetration of building structure and the availability of chipsets at VHF. To permit the incorporation of video aspects into alarm systems, data speeds of 100 – 200 kbps are required, in comparison to the low data rates of 2.4 – 9.6 kbps for domestic equipment.

Although the average range requirements of alarm systems below 100 m (indoor), there are many instances where transmission distances of up to 800 m (outdoor) are needed.

One of the standard requirements (e.g. by CENELEC) for wired fire and security systems is a continuously operating system diagnostic, requiring a duty cycle of 100%. Due to cost constraints, the Industry has resisted the use of sophisticated transceivers even though there is a growing recognition that the use of LBT/AFA and other mitigation techniques to allow the 100% duty cycle requirement to be achieved without the need for dedicated channels. The current availability, of low cost chipsets incorporating these and other resilience techniques can be expected to increase the implementation of the wireless alarm systems

Increasingly, movement detection using Doppler microwave sensors, in most cases to complement Passive Infra Red (PIR) units, are incorporated into alarm systems. These operate predominantly in the 10 GHz bands, with some at 24 GHz. It is estimated that around 50% of commercial and 25 –30% of domestic systems are so equipped.

Market data

In the USA, currently around 30% of domestic households are equipped with security alarms compared to only 12% in the EU. However, the alarms industry is confident that over time this will progressively change.

In the ‘professional’ Industrial/Commercial Sector, there is a further demand for the incorporation of video stills or sequence capability to enhance alarm verification. Although the ratio of commercial to domestic units is approximately 1:3, the need for higher quality equipment compensates in market value terms.

The size of the alarms market has been estimated at between 32 and 40 million systems for the EEA, noting that this describes systems with several nodes leading to an estimated number of transceivers in the region of 100 million or more.

Other users of alarm systems are plant operators (machinery, process control etc.) whose use of SRDs has been growing steadily. Most utilise the 433 MHz band, although there has been progressive migration to the 868 – 870 MHz band to alleviate instances of spectrum overcrowding in the 433 MHz band. Again, such systems demand a high duty cycle commensurate with the speed at which alarm situations can develop. The numbers of multi node systems installed to date are estimated at no more than 20 million systems, with an annual rate of increase of approximately one million.

6.1.7 Building Automation

Building automation devices are becoming a mass market with real end-user benefits. Automatic lighting or heating management brings comfort and energy saving whereas central closure (doors & windows, shutters, etc.) management assists security.
The market for building automation devices has embraced wireless solutions because they simplify and accelerate installation.

The requirements of building automation include:

1. Short delay: a rapid response to transmitted commands is essential.
2. Signal transmission reliability: the control address must be guaranteed to reach the target.
3. Point-to-point communications must be able to cover a whole building environment[3] without recourse to the use of repeaters.
4. Control devices are battery powered with 5 -10years life time to virtually eliminate the need for regular maintenance.

Consequently, taking into account the above requirements, technologies in the 2.45 GHz are unsuitable. Indeed, due to the poor propagation inside a house the required range and life duration cannot match the end-user expectations. Consequently, lower frequency operation is preferred e.g. in the 863-870 MHz, 433 MHz bands or below.

The 863-870 MHz band is used for added value devices requiring reliability and advanced functionalities whereas the 433 MHz band is preferred for simple devices.

The data rate used is generally not more than a few tens of kilobits per second (kbps) e.g. 19.6 to 38.4 kbps, a compromise between acceptable current consumption and functionality.

There has been a separate and growing interest in single variable, battery powered wireless sensors. The combined availability of low cost chip based transceivers with long life batteries has enabled “fit and forget” to become a reality. The range of sensors which use this technique include temperature and humidity units that are commonly used to monitor parameters such as pressure, flow and molecular sensing. The scanning requirements for high quantity single sensor networks are low data rate but high speed scanning coupled with a long (typically 400 m) range. As with building automation devices, operational frequencies that give good building structure penetration without recourse to repeaters are required.

The domestic appliance market is actively investigating the use of SRDs to enhance their products in various ways e.g. fridges or freezers that transmit a signal either to a house monitoring system or mobile phone when specific conditions such as incorrect temperature, are met.

[3] Communication range reference is a 200m² house with 3 floor plans with concrete walls and ceilings. External applications require a range of several hundred metres.

Further, many energy management systems use Doppler microwave motion sensors, operating primarily in the 10 GHz SRD bands for occupancy detection. Such sensors provide reliable and consistent performance in a range of room sizes from domestic to large sports halls and arenas. The use of the 24 GHz band for this application is limited because of the restricted detection range.

Market data
A study provided by European industry leaders gives the following home-building automation device figures as detailed in Table 1 below.

Table 1: Home Building Automation devices in 2005 and 2010

Parameters	2005	2010
SRD units supplied annually	5 million	10 million
Systems installed to date	10 million	70 million
Annual Turnover	€10 000 million	€15 000 million
Work force	1 million	2 million

It is noted that once installed, building automation devices must work for years. The typical end-user lifetime of these devices is expected to be in the order of 10 to 15 years without any performance alteration. This implies that long-term stability in terms of designated frequencies is crucial to ensure certainty for industry and users.

6.1.8 Access Control

Access control systems include devices such as garage door openers, vehicle door management systems, automatic door openers used for energy management, disabled persons access and building security applications.

Historically, these systems have employed ultra-low cost build procedures and one-way transmit operation only. They remain, and will continue to remain, sold in very large numbers. Interest in using multi channel or frequency agile transceiver is very low. Duty cycles in both types of system are very low and instances of mutual interference to date are rare, though increasing. Range requirements vary from 10m to 100m. Additionally, microwave based automatic door sensors operate almost exclusively in the 24 GHz SRD band, where their short range performance and continuous coverage pattern match operational requirements.

Market data
While official figures are unavailable, to date it appears that over 100 million door openers, mainly using the 433 MHz band and approximately 50 million car access units have been installed. The rate at which the domestic access market is developing shows a steady increase, of approximately 10 million units annually.

There are approximately 5 million 24 GHz automatic door sensors currently installed in the EC, increasing by approximately 1 million per year.

It should be noted that access control is also a term used to describe some forms of RFID. The market figures given above do not include RFID products.

6.1.9 Telemetry and Telecontrol

One of the first SRD applications to be exploited was telemetry applications. Their application and degree of complexity vary enormously. At one end of the scale, radio telemetry is widely used to monitor and control utilities such as pumping stations and electricity networks, operating over several kilometres, to in-plant monitors operating over a few metres. This sector also includes crane and machinery control. The main SRD bands used for telemetry and telecontrol depend on their application. Typically bands below 1 GHz are used but the 2.4 GHz band is heavily in use by video applications.

The duty cycle requirements for telemetry and telecontrol devices vary from between 0.1% and 100%. For general-purpose telemetry, data speeds of 2.4 kbps to 56 kbps to cover most applications. It is in this range that there has been a consistent need for narrow band, high quality transceivers. The main requirement for telemetry systems is to function correctly in adverse operational environments reliably. Therefore it has been this market that has driven moves towards frequency agility and LBT techniques.

Market data
The telemetry and telecontrol market has been one of the longest to exist and is estimated to produce an annual turnover of approximately €1000 million.

6.1.10 Non-Ultra Wide Band Consumer Devices and “Toys”

The current work within CEPT ECC TG3 on Ultra Wide Band (UWB) demonstrates the drive among large chipset manufacturers to produce low cost, high volume SRDs that can achieve high data rates. Markets for these devices are likely to include the home computing /multimedia entertainment market.

The simultaneous availability of conventional wideband, very low cost chipsets operating below 1 GHz can be expected to stimulate the integration of radio into other, as yet unconsidered, consumer products.

Market data

Detailed estimates of these markets could not be made within the timescale of this Report. However, interference issues may be inevitable due to the quantity, mobility and sometimes low quality of these devices.

The advent of low cost (€1-3) chipsets to produce workable radio transceivers over relatively short ranges either without an antenna or with an integral one has created possibilities to enhance a whole range of products with wireless capability. Although it is expected that the range of these devices will be short, persistent interference could damage the reputation of the SRD industry.

6.1.11 Mixed Speech and data

Low cost digitised speech chips are now available. However where high duty cycles are in use it is practically impossible for the casual observer to distinguish between telemetry data and speech. Within the Alarms Industry and Telemetry industries, there is increasing demand to incorporate occasional speech and video to background scanning to aid diagnostics and the verification of sensor based data. Achieving high data rates demands wider bandwidths. This, inevitably, will accelerate the pace at which spectral overcrowding occurs. Equally inevitably, this will occur most often in urban hotspots. For wireless audiovisual units, for both consumer and professional markets, UHF and Super High Frequency (SHF) spectrum is sought with wideband access.

Market data
At present, no reliable overall market data has been located.

6.1.12 Professional Radio Microphones

Probably the first "SRD" having started in the late 1940s (although there is a patent dated 1908) but mainly limited to Official Broadcasters until the 1970s when the rise of pop groups and musicals in film and theatre requiring high quality reproduction of voice and music started the migration to the professional entertainment sector which has since exploded with most programmes now being made by private companies and sold to the networks.

As an example of the prevalence of radio microphones, the European Song Contest uses up to 800 radio microphones and a typical theatre musical production up to 52 simultaneous channels (the average number in London's theatre land is 35).

Professional radio microphones require protected spectrum due to the 100% duty cycle and are typically connected to vast sound systems or recorded for radio or TV transmission. To date this protection has been provided by the licensed use of the TV bands 3, 4 and 5 on a geographical restricted basis, but with the switchover to digital TV there is an impending crisis in the industry as the only other spectrum available for large multichannel systems is in the 1785 MHz band but does not provide equivalent propagation characteristics or sufficient spectrum.

Radio microphone manufactures are for the most part comprised of Small to Medium sized Enterprises and the Research and Development (R&D) required to change from an FM based VHF/UHF system which had been developed to a peak of performance to digital systems with their lip synchronisation problems caused by time delay when using digital compression and lack of available spectrum for multichannel systems has proved a large challenge to the industry. This has resulted in a much larger bandwidth requirement (600 kHz instead of 200 kHz) for digital systems.

ERC Reports 38 and 42 provide an in depth study of the use of this equipment.

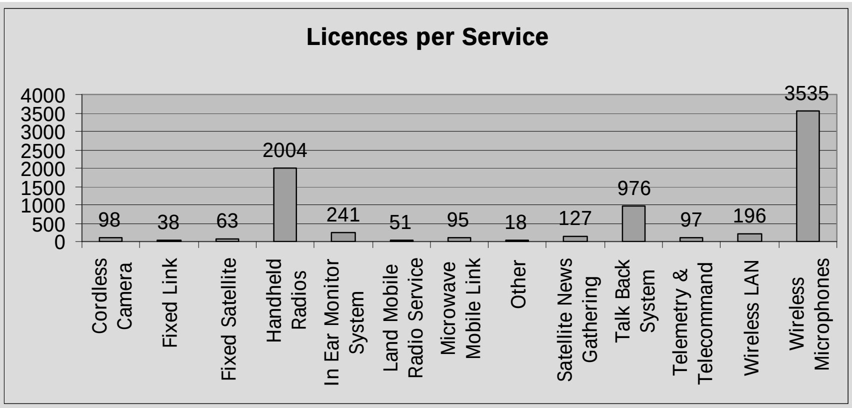
Radio microphones are the subject of the first international standard produced by the Global Standards Collaboration. During the drafting process it was found that the differing spurious limits imposed by the different ITU regions was a major hurdle.

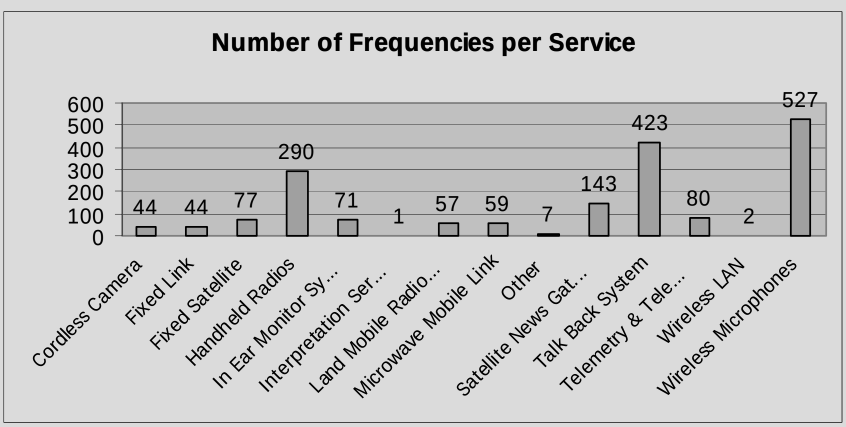
It is difficult to provide accurate financial statistics on the contribution of radio microphones to the European economy. Despite this, it is difficult to imagine any public performances which do not make use of them. Touring pop groups such as the Rolling Stones and U2 rarely gross less than two million euro per show and large sporting events such as the recent Olympic Games in Athens would not be able to function without radio microphones. A major broadcaster estimates an average of some €160,000 for the use of radio microphones and their staff for each programme.

Market data
The professional radio microphone market continues to expand year on year but the market size is limited due to the high cost of professional equipment (some thousands of euro per channel). Due to the disparate nature of users and long life of equipment (above 20 years) it is difficult to provide detailed data, but the data collected by the Wyndham Report 1997 gives an indication for the UK theatre industry which will be repeated in other European Countries. It is reasonable for the entertainment industry to include within its benefits to GDP the associated direct income from tourism.

1997 UK theatre receipts: 589 million Euro
For London the increase in tourist expenditure was calculated at 618million Euro
These figures are borne out by similar studies in New York.

A second example is their use at the 2004 Athens Olympics.





6.1.13 Cordless Audio and Consumer radio microphones

Unlike professional radio microphones, consumer radio microphones proliferate at a great pace, being used for a wide range of activities from video cameras to sound reinforcement for street market stalls, amateur dramatic performances and seminars/meetings. Consumer radio microphones cost from €50 upwards.

Cordless audio devices range from cordless headphones and speakers mainly using the deregulated 863-865 MHz band, to aids for the hearing impaired operating in various UHF and VHF bands.

A recent addition to the cordless audio range of devices is the micro FM transmitter operating on the Broadcast Band II (87.5-108 MHz). These devices use a stereo audio feed from an MP3, CD player or DAB adaptor and transmit a signal to a standard car radio or Band II receiver. It is estimated that 5 million illegal devices are already in use but a regulatory solution for these devices has just been published by CEPT in the revised ANNEX 13 of ERC/REC 70-03 on Wireless Audio Devices which legitimises the use of these devices. Manufacturers that have not yet sold this product on the EU estimate in the order of 8-10 million devices to be sold in the first 18 months of placing such devices on the market, with steady sales after that of the order of some 5-6 million units per year.

Cordless speaker sales will increase as the multi channel cinema sound systems arrive onto the market and following the revision of Annex 13 of ERC/REC 70-03 to permit micro FM transmitters. Similar to cordless headphones, these systems can either have the transmitter built into the TV or Hi-Fi or can be stand-alone units which use an audio feed from the main unit.

Market data

At present, no reliable overall market data has been located.

6.1.14 Radio Local Area Networks

Radio Local Area Networks (RLANs) were introduced in the early 1990's when the ECC and FCC designated spectrum for this application in 2400 – 2483.5 MHz. In 2003, a total 455 MHz of spectrum in the 5 GHz band became available worldwide thanks to an agreement between industry and representatives of the radio location service (radars). The CEPT Joint Project Team "JPT5G" played a crucial role in developing this agreement.

Since the inception of RLANs, numerous designs and technologies have been put on the market but today the market for RLANs is dominated by products compliant to ISO 8802 and its IEEE pre-cursor, the IEEE 802.11 standard. Interoperability of RLANs is assured through certification by the Wi-Fi Alliance, a non-profit organisation with a large, world-wide membership. It is estimated that over 200 million RLAN devices are in use today and this number is still growing. This testifies to the fact that RLANs have become a large and profitable industry.

The services provided by RLAN systems are basically the extension of wired local area networks (Ethernet) over distances ranging from less than a metre to a few hundred metres. The latter requires the use of directional antennas in combination with reduced output power. Applications range from simple wireless access to video streaming in the home to public internet access provided by major operators. Also worth noting is that dual mode mobile/RLAN products are appearing on the market. These give the user a choice of using either the mobile service like GSM or UMTS, or, if locally available, an RLAN access network.

Due to the on-going convergence of digital services in the Information Communications Technology (ICT) sector there is a case to be argued that some of the new SRD devices (e.g. RLANs) from the ICT sector can be considered as generic wireless networking devices that can perform a multitude of functions. These functions may be used to replace some of services previously supplied by an individual designation applied to a specific type of SRD application. A good example of this is using RLAN technology to provide video surveillance with IP-based cameras using RLAN spectrum rather than dedicated video bands using analogue cameras.

Currently RLANs provide data rates up to or in excess of 108 Mb/s. The medium access protocol (CSMA/CA) is a listen-before-talk protocol that is designed to avoid collisions during medium access. Thanks to this sharing mechanism, RLAN operations are extremely robust and high density deployments are quite common – e.g. 1200 users in a single convention centre. RLAN technology continues to evolve: work in hand at the various standardisation committees includes High Throughput - for data rates expressed in multiples of 100 Mb/s – and Mesh Networking.

Examples of RLAN technologies that have appeared on the market up to today include Wifi™, HomeRF™, ZigBee™, Bluetooth™ but other wireless networking technologies (proprietary and non- proprietary) do exist or are currently being developed and will appear on the market soon.

6.1.15 Machine to Machine (M2M)

In the context of this report M2M is defined as the combination of two or more wireless transmission systems in a single, hybrid product. M2M is a concept for connecting different devices (e.g. "machine-to-machine", "mobile-to-machine" communications) to transmit or receive its data remotely over a network; this network could be a fixed wired or wireless network. In the SRD market, M2M is used most commonly where data needs to be concentrated at a location which is remote from the points of collection.

M2M applications are based on communication networks for machine monitoring, control, and alarms. They can be installed anywhere using interfaces for a great number of applications to any type of mechanical, electrical, electronic machine.

The following applications are just a few typical examples:

- Remote Data Collection (state of machines),
- Remote control (management),
- Telemetry (sensors, measurements in real time),
- Remote payment (home banking),
- Wireless in healthcare,
- Telematics (Intelligent Transport, navigation),
- Remote monitoring (access control, management of alarms, emergency services),
- Teleinformation (Internet cafes or other public Internet access points)

Many SRD bands within the VHF and UHF range could be used by wireless M2M applications.

The growth in M2M applications will result in an increased use of the spectrum. There is a need to check the suitability and the constraints of available bands for M2M applications. Depending on the future M2M requirements (e.g. higher data rates), there may be a need for additional spectrum.

The use of M2M for domestic systems can be seen as a market evolution that requires more investigation. M2M applications can be also used in the professional area, for example, B2B, B2C, B2B2C (Business to Business, Business to Consumer, etc.) to interconnect with networks, including mobile.

The principle use of M2M in this context is therefore as a means of increasing the market penetration of most of the generic SRD applications within this section.

6.1.16 Combined Devices

In addition to the stand-alone use of the various SRDs described above, SRD combinations are starting to appear. One such case is that of mobile phones which will combine:

- Band II micro transmitter for playing downloaded music onto a Band II receiver.
- RLAN technologies for connection of headset or car hands free.
- RLAN technologies for connection to the internet or data to and from a PC or PDA.
- Transmission of video or data to and from a PC or PDA using RLAN technologies
- Transmission of video or data to and from a PC or PDA using UWB

In addition to:

- DVB-H receiver
- Tri or quad band cellular transceivers
- DAB-T receiver

Market data
At present, no reliable overall market data has been located.

6.1.17 Aviation and Maritime applications

The air transport industry has started to use a range of SRDs inside aircraft for both remote sensing and data transmission to maintenance workers when the aircraft is on the ground. At a later stage airborne applications may be introduced.
Similar applications are to be found on other forms of transport including ships.

6.2 Market and Technology Trends - Conclusions

Some trends and conclusions that can be drawn from this section are as follows:

a) The simultaneous availability of low cost, intelligent radio transceiver chipsets and long life batteries have produced the conditions to permit the rapid increase in the sales of SRDs.

b) The increasing public awareness of the benefits provided by wireless technologies has generated a wide acceptance of the advantages of its use.

c) The pressure on existing SRD spectrum in all bands is likely to increase, especially in hotspots. SRDs currently operate on the basis of non-interference and no-protection. To meet the challenges presented by the need for sharing, the SRD Industry has developed frequency agile and intelligent radio devices that can detect any existing use of a given radio channel. Industry believes that it should be able to exploit that versatility through access to other frequency bands. Such access must however necessarily follow careful analysis of the consequences of such deployments for other users of the chosen frequency bands.

d) In order for a strategy to emerge, a continuous study of SRD market applications should be established to anticipation the future spectrum needs of SRDs and to develop usage policies accordingly. For example, in the recently reorganised 863-870 MHz band market predictions for RFID suggest that its use will extend to consumer applications. The predictions suggest that the present designation of 3 MHz between 865-868 MHz will be insufficient to cater for the vast numbers of RFID deployed. It is therefore imperative to ensure that suitable additional spectrum, preferably close to the existing RFID band, is identified in sufficient time to cope with this requirement.

e) With the introduction of "open highways" to more generic SRDs, consideration should also be given to designations for specific SRDs applications, where justified. Any resulting strategy must recognise the necessity to provide reasonable protection for SRD and non-SRD legacy products.

f) For SRDs that inherently possess a "safety critical and/or life supporting" implication consideration should be given to dedicated bands which are subject to defined use as identified in ERC/REC 70 – 03. However, such applications should be encouraged to adopt spectral efficiency techniques both in terms of radio characteristics (e.g. LBT/AFA) and data transmission (e.g. time critical data transfer). It is important that the particular needs of those kinds of SRDs (where no other solutions are available) are or will be used in the healthcare, aviation, maritime and railway sector, are taken into account.

g) Last, but not least, the cross border problem for the use of safety critical and/or life supporting SRDs must be solved urgently, in order to have all those applications/technologies available in any country of the world in the interest of the health and safety of people and animals.

The above factors have produced a marked acceleration in SRD applications indicating the probability of a massive expansion in installed products. This demand will continue, in particular where increased sophistication of operation is required.

Note

The discussion in this "Market and Technology Trends" section of the Report has focussed primarily on SRD occupation in spectrum below 1 GHz. With the exception of the 2.4 GHz ISM band, the 5 GHz Radio LAN bands, the 5.8 GHz ISM band, the 10 GHz band and 24 GHz radar applications the SRD Industry has not yet greatly exploited spectrum above 1 GHz.

The principal reason for this has been the lack of availability of cost-effective components at these higher frequencies. The advent of mass market SRD will however change this as major microchip manufacturers will be encouraged to develop components for operation in this spectrum.

7. Economic, including social, considerations

In any analysis of the economic, including social, impact of SRDs it is also necessary to take into account the fact that allocating spectrum to SRDs may impose limits on the usability of that spectrum by radio services. This imposes a cost in terms of the loss of benefits that may have been created from those services that have been denied access to this spectrum. In addition to this, it should be noted that, as most SRDs are not individually licensed and there is no record of their users or locations, it is extremely time-consuming and difficult to clear bands of SRDs so that they may be reassigned to radio services. Thus, the designation of spectrum to SRDs represents a long-term commitment.

Producing impact assessments for SRDs may initially be difficult because many of them are incorporated into larger capital goods such as process plant, vehicles, etc. There are also social aspects to be considered, which are difficult to quantify. The benefits could be intrinsic, such as the value of social or medical surveillance systems and healthcare or extrinsic in considering the added value to other products, including “invisibles” such as tourism that the addition of SRD technology makes. However, these aspects also apply to many other areas of radio spectrum use and the difficulty in determining the costs and benefits of the SRD sector should not be used as an excuse not to perform such an analysis.

Estimating costs and benefits of different options is not an impossible mission and there are a number of techniques that can be used to determine the impact on either GDP or consumer and product surplus[4]. Carrying out an assessment to determine the maximum benefit to be gained from the use of a scarce resource is an essential part of any successful commercial activity. Impact assessments are a sound basis for decision making and the principle has now been embodied into the Commission's draft EC Decision to establish a framework for the harmonisation of SRD spectrum. Some administrations have considerable experience of the application of Impact Assessments and the process will become easier as the degree of expertise develops.

While the income from licences is fairly easy for national radio administrations to quantify, they should be disregarded for the purposes of this analysis. The fact that radio services generate licence fee income, whereas SRDs do not, is not a factor that should be taken into consideration. Indeed, the imposition of fees to maximise revenue generation is not permitted under the European framework as it is not relevant to securing optimal use of the radio spectrum. In any case, benefits to taxpayers from licence fees are a transfer payment rather than a net benefit to the economy.

[4] Consumer surplus is the difference between the value consumers attach to a product or service and the amount they pay. Producer surplus is similar but from the producers' perspective and is closely related to and often known as profit. The figures involved tend to be greater than those for consumer surplus. The sum of producer and consumer surplus is one measure of the total welfare benefit generated and is widely used by economists.

8. The Existing Short Range Device Regulatory Environment

This section examines the current definition of SRDs and outlines the strengths and weaknesses of the current regulatory environment for SRDs. A review of the effectiveness of the associated procedures in the context of the EU main policies and objectives is also provided.

8.1 Current Definition of SRDs

The acknowledged definition of SRDs is described in the *Introduction* section of ERC/REC 70–03 and is further expanded on under the *considerings* and *recommends* sections of that Recommendation. This definition is as follows:

"The term Short Range Device (SRD) is intended to cover the radio transmitters which provide either uni-directional or bi-directional communication and which have a low capability of causing interference to radio services while cannot claim protection from radio services. SRDs use either integral, dedicated or external antennas and all modes of modulation can be permitted subject to the relevant standards"

Responses from a wide range of companies that produce SRD products or services indicate that the current definition is considered adequate by the industry.

8.2 Scope of Regulations and Standards relating to Short Range Devices

The following instruments currently apply to Short Range Devices within the EC:

a) ERC/REC 70-03;
b) ERC/ECC Decisions ;
c) ETSI Standards;
d) Radio and Telecommunications Terminal Equipment (R&TTE) Directive, Directive 1999/5/EC and relevant EC Decisions.

These instruments are examined in greater detail within this section of the report.

8.3 CEPT/ERC Recommendation 70-03

ERC/REC 70-03 on Short Range Devices was developed by WG FM in the mid-1990s in order to bring together and consolidate the multiplicity of Recommendations on SRDs or low-power devices as they were then called, and to present a clear and coherent overview of the spectrum available and associated technical and regulatory parameters for the various types of SRD.

Each CEPT Administration has a national legislative framework for the operation of Short Range Devices (SRDs) in their territory. In many cases this consists of the development of appropriate operating parameters which when complied with allow SRDs to be operated without the requirement of a licence. The operating parameters for SRDs in CEPT Administrations are largely based on ERC/REC 70-03. Where the operating parameters of a specific band or application in an Administration differ from those published in ERC/REC 70-03 a note of this deviation is included in Appendix 3 of that Recommendation as a National Restriction. In addition individual Administrations may also have additional frequency bands available for SRDs beyond those detailed in ERC/REC 70-03.

ERC/REC 70-03 is subject to on-going revision in order to keep abreast of the requirements of the SRD industry and is maintained by the Working Group Frequency Management (WG FM) project team, Short Range Devices Maintenance Group (SRD/MG).

8.3.1 Effectiveness of ERC Recommendation 70-03

ERC/REC 70-03 is effective for the following reasons:

1. It aims to resolve fragmentation of SRD requirements among CEPT Administrations;
2. It provides a centralised and up to date guide on SRD requirements for industry reference;
3. The operating parameters of SRDs detailed in the Recommendation facilitate "peaceful co-existence" between services;
4. It promotes the harmonisation of frequency bands and requirements for SRDs;
5. It provides a route to Class 1 status for radio equipment under the R&TTE Directive;
6. It acts as a guide to CEPT Administrations on industry requirements;
7. Its usefulness has resulted in industry expressing broad satisfaction with the ERC/REC 70-03 concept;
8. Spectrum sharing compatibility between different SRD applications ensures reliable operation of applications and thereby enhances market credibility.

On the other hand, the effectiveness of ERC/REC 70-03 is hampered for the following reasons:

1. The approach is largely reactive to spectrum requests from industry and the market;
2. The level and speed of Administrations' implementation can act as a regulatory barrier to trade in that it may unduly prolong the time for a product to be placed on the market and may stifle harmonisation; Lack of implementation results in applications being classified as Class 2 under the R&TTE Directive;
3. In some cases, harmonisation can be stifled by band fragmentation;
4. In considering new applications, it should be noted that too many specific Annexes to ERC/REC 70-03 may lead to inefficient use of spectrum;
5. There is regulatory certainty only within the existing annexes. This may be a barrier to spectrum access for new technologies for which regulatory certainty cannot be ensured until the Recommendation has been revised accordingly;
6. Lack of legal status of ERC/REC 70-03 creates uncertainty for manufacturers.

8.3.2 Industry Views on Recommendation 70-03

In a questionnaire generated by industry and sent to LPRA, EICTA and ISAD members, the question "are you satisfied with the form of Recommendation 70-03 as a framework for regulations affecting your products" was posed. Although the general answer to this question was yes some reservations and observations were raised.

Members were generally satisfied with the concept of ERC/REC 70-03 but were dissatisfied that it is only a Recommendation which means that Administrations have a choice about whether or not they accept it. The concept of a single document in which all the SRD technical requirements are referenced is popular. However there is a need for awareness and study of the following issues:

R&TTE classification
National frequency tables and corresponding notes
National frequency interface descriptions for SRD

Decisions of the Telecommunications Conformity Assessment and Market Surveillance Committee (TCAM), the steering committee under the R&TTE Directive, and the EU Commission legal service interpretations are regarded by some as cumbersome, time consuming and poorly understood. TCAM documents should be made more widely available.

A situation under which all CEPT Administrations are committed to the implementation of ERC REC 70-03 in reasonable time scales is sought in order to realise the actual harmonisation which is acceptable to market.

Thereafter, there may be a requirement to change the regulations, which may require the retesting of current products and design changes. Since this can be disruptive and expensive, amendments to ERC REC 70-03 should be made only when, for example, distortions to radio spectrum use necessitate them. Even then, reasonable time is needed by the SRD industry to accommodate these changes, both to avoid disruption to production and to afford protection to their existing systems.

It must be recognised that, particularly for corporate manufacturers, planning and product development phases can be as long as 3 years, with a product life expectancy of 10 years or more and actual use in situ for several years more. By contrast, typical "consumer" products may be on the market for only 1 or 2 years following the minimum possible design commitment and expectation of short product life. Proposed regulatory changes need to be phased in to take this into account.

Commonly, it is found that CEPT-ECC, TCAM and ETSI deliverables are not always in alignment and are sometimes in contradiction with each other. There have been occasions where the currently published status of one document is outdated with reference to others.

The ERO website could be the "one stop" source for all regulatory data, although industry considers it difficult to use.

Although the SRD industry in general embraces the market freedom and reduction of conformity costs, there is a widely held view that the lack of clarity in the implementation table of ERC/REC 70-03 can cause difficulties.

8.3.3 Is Recommendation 70-03 generic enough?

In drafting this Report, some discussions took place about Recommendation 70-03 and whether it was generic enough. It was felt that making it more generic where possible would offer industry more spectrum options, allowing SRD applications to get spectrum access promptly if in compliance with certain regulatory requirements. As these concerns arose due to the number of Annexes of ERC REC 70-03, an assessment was therefore made on the reasons for their creation. See Annex 4 of this report.

This structure agreed between CEPT and Industry at the time of Rec. 70-03 was created with two main objectives:

- as an easy to understand reference document for non-regulatory experts especially SMEs which typically represent the majority of manufacturers in the SRD market;
- as an easy and fast mechanism for updating the regulatory requirements for SRDs. The revisions to the annexes of Recommendation 70-03 and the speed at which this is done demonstrates that this is an efficient and dynamic process

8.3.4 Conclusive notes on the generic nature of Recommendation 70-03

The explanations provided in Annex 4 of this Report clearly show the following:

- Much of ERC/REC 70-03 is already generic. In particular, Annexes 1 and 9 because they are application-neutral, cover a wide range of SRD applications and do not offer any level of protection. The Annexes 2, 3, 4, 8 and 12 are specific. All other Annexes have a fairly wide range of applications. It should be noted that the vast majority of SRDs operate in compliance with these generic or partially generic Annexes.
- Some Annexes of ERC/REC 70-03 are specific because they deal with particular applications requiring (all or combination of, or single case applies):
  * protection of use to some extent (not usually offered by the generic Annexes)
  * specific limits because of spectrum sharing with Primary Services
  * higher power than usually applies to the generic Annexes.

ERC/REC 70-03 has, in a limited way, already introduced the concept of an "Ultra Low Power SRD class" e.g. Annex 9 and 12. However, further introduction of this concept may be pursued, subject to appropriate study and necessity.

8.4 ERC/ECC Decisions

There are approximately twenty ECC and ERC Decisions relating to Short Range Devices. These Decisions, which were based on ERC/REC 70-03 are regarded as useful tools for encouraging harmonisation and, given that they laid down a definite set of requirements, they provide regulatory certainty for Administrations and industry. These Decisions are subject to periodic review within the Electronic Communications Committee (ECC) and where they have been rendered obsolete or unworkable due to changes in the direction in industrial developments and market trends they are proposed for abrogation.

8.5 Standards

In general, criticism of the content of ETSI, CEN and CENELEC standards for SRDs seems minimal. Indeed the openness and availability of ETSI standards, which are free to download from its website (www.etsi.org), has been widely acclaimed. Despite this, in some cases ETSI Standards refer to standards produced by CEN/CENELEC and these standards are not freely available. Further, the rate of production and implementation of CENELEC standards relative to ETSI ones is slow. The reasons for this should be investigated with the objective of speeding up the overall CENELEC process.

There is an ongoing question relating to 'Voluntary Standards'. The concept is regarded as confusing even to European manufacturers and importers, particularly from the Far East. It would be advisable to incorporate an explanation of the application of a voluntary standard in ERC/REC 70-03.

8.6 The R&TTE Directive

The R&TTE Directive has replaced the old system of type approvals for radio equipment. Equipment, which can be placed on the market and put into service without restrictions, has been designated as "Class 1"under Commission Decision 2000/299/EC. Equipment for which there are restrictions in terms of placing on the market and/or putting into service is designated as "Class 2". For Class 2 equipment, the relevant spectrum authorities where the product is to be marketed must be notified at least four weeks in advance of the equipment being placed on the market.

The benefits of R&TTE 'Class 1' status include the development of internal market and the free circulation and use of products across Member States.

Problems hampering 'Class 1' status include the fact that these usually encompass the 'Lowest Common Denominator' approach which may not always benefit industry or users and Multi-band products tend to be classified according to the lowest common equipment class (e.g. dual/tri band 2.4 GHz & 5 GHz RLANs are classified as Class 2).

8.6.1 R&TTE Compliance from Industry's Perspective

The principle of the R&TTE Directive is generally well understood. However criticism is widespread over its presentation and interpretation. The Europa website, giving the text of the Directive is universally disliked. It is regarded as contradictory to the objective of providing industry with clear and unambiguous information on issues surrounding the Directive. In addition, the deliberations of TCAM are not generally available to industry.

R&TTE was established as an instrument to open the EU market and remove national barriers to trade. However, the existence of the National Restrictions in Appendix 3 of ERC/REC 70-03 is seen by many as evidence of the failure to realise this concept. The Class 1 list and the implementation of the "lowest common denominator" concept (e.g. for e.r.p.), is regarded as weakening the whole objective. There is a clear case for harmonisation in shorter time scales that are acceptable to the industry.

For Class 2, there is demand for a "one-stop, on-line notification" which should be interactive, should inform manufacturers of any restrictions, national power limits and any other special conditions (i.e. indoor/outdoor use). This would save much time and cost to manufacturers for the placement of products on European markets.

Consideration should be given to the actual effect of the introduction of the R&TTE principle and its effect on European competitiveness. If the regulations for introduction in the USA and Far East are contrasted with those of Europe, the outstanding tenet is that of obtaining Type Approval which has now been abolished in Europe. This could be seen as giving imported products a competitive edge. Every effort should therefore be made to persuade other global regions to adopt the "open market" principle as used by the EU under strict time constraints.

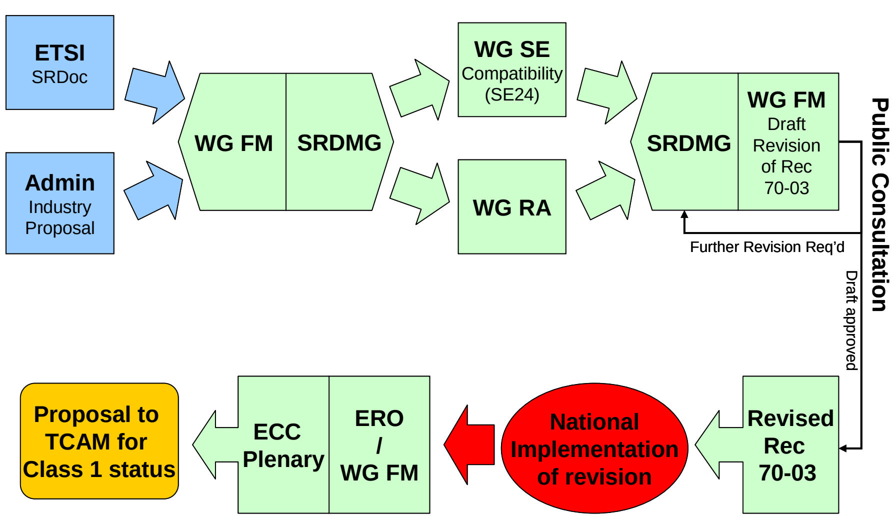
8.7 Effectiveness of the current Regulatory Process

Figure 3 below depicts the current procedure for identifying new spectrum for SRDs for formal requests for consideration by the SRD/MG. These requests can originate in industry, often through ETSI, or from Administrations that have identified a specific need for a new application. Such requests are considered by WG FM and, where necessary, are passed to the SRD/MG for any necessary compatibility and regulatory assessments and a recommendation on any required further action. Any recommendation for modification of ERC/REC 70-03 that is provisionally agreed by WG FM will be sent out for public consultation before reconsideration by SRD/MG and WG FM.

After due consideration of comments to the public consultation, the modification will then be incorporated into the published version of ERC/REC 70-03. If WG FM cannot resolve divergent positions the matter is raised at the ECC level for resolution and the ECC again would conduct a public consultation on the modification proposals. The ECC has recently established a more stringent approvals process for the instigation or modification of an ECC Decision. In this case formal ECC approval is required before work can commence on such a draft Decision. Following development in SRD/MG, WG FM would send the draft ECC Decision out for public consultation. After consideration of comments from the public consultation process and if appropriate, the final draft Decision would be sent to the ECC for formal adoption. The assessment of requests for new spectrum for SRDs should take into account the opportunity cost in terms of the effect on spectrum for licensed services as part of any impact analysis. This is dealt with in Section 9.5 and Section 9.8 of this Report.

In parallel with the CEPT process outlined above, ETSI generally develops a harmonised standard (EN) for the relevant SRD application. During this process ETSI will liaise with WG FM, WG SE and the SRD/MG for information relating to appropriate operating conditions to ensure compatibility with existing services.

Figure 3: Current Regulatory Process for SRDs in CEPT



The benefits of the current regulatory process include:

1. Defined entry points into the process for industry;
2. Compatibility studies within WG SE ensure:
    - compatibility with existing users;
    - maximum/efficient use of the spectrum;
    - reliable operation of the new application by definition of appropriate operating conditions;
3. WG RA advise on practicalities of regulatory proposals;
4. Process of public consultation should ease the process of national implementation.

ECC Policy Goal 10 aims to increase the efficiency of the regulatory process, particularly the compatibility studies, and to provide a rapid frequency designation process and to give a higher degree of certainty for industry. A key element of this is to encourage the industry to provide initial spectrum studies to support its proposals.

The disadvantages of the current CEPT regulatory process include:

1. The overall process is time-consuming and may not align with the short life-cycle of some products. However this is not the case for most SRDs, where planning and product development phases can be as long as 3 years, with a product life expectancy of 10 years or more;
2. Micro-management of individual applications/bands is not efficient for generic SRD purposes;
3. In some cases, there is too much emphasis on providing protection for existing services and a more balanced approach should be pursued;
4. Compatibility studies can be a lengthy process to complete;
5. Level and speed of implementation by Administrations may stifle harmonisation;
6. In the absence of full harmonisation of the technical requirements given in ERC/REC 70-03, Class 1 on lowest common denominator basis is not always useful.

8.8 Shortcomings of the Current Regulatory Environment

Some of the frequency bands identified for SRDs in CEPT Recommendation 70-03 have been in place for many years before ERC/REC 70-03. They came from a process of meeting the needs of individual manufacturers or groups of manufacturers and from a CEPT initiative to open up the ISM bands for SRDs.

More recently, a more structured approach has been agreed with ETSI developing a Systems Reference Document which is intended to represent the views of industry, users and interested parties generally. This has moved CEPT away from a procedure that could be used to favour the narrow interests of individual manufacturers that could give them an undue advantage in the commercial market place.

Of increasing relevance to the European SRD market is the emergence of products originally designed for other radio regions including those compliant with FCC rules. A further issue is the emergence of products meeting specifications drafted by other international standards organisations other than ETSI such as the IEEE 802. Companies previously experienced in the computer networking industry primarily drive the IEEE 802 standards body.

This has led to a split in ETSI's role particularly for the SRD market. Telecommunications and other mainly non-networking products manufacturers still tend to start development of their products and standards within the ETSI process. The wireless networking industry only tends to involve ETSI when it sees a need for a harmonised standard to meet the requirements of the R&TTE Directive. ETSI at present prepares European harmonised standards for technologies developed by other standardisation bodies. It works with Global Radiocommunications Standards Collaboration (GRSC) and ETSI has agreements with a range of standards organisations, including IEEE, for the mutual development of protocols.

As mentioned elsewhere in this Report manufacturers look for the widest market for their products in order to get the greatest return on their original investment and this has led to a number of illegal products entering the European market without any spectrum allocations. There is a need to determine whether the European regulatory regime can be modified to accommodate these products. An element of this decision is the practicality of taking any action against transgressors – i.e., is there a public demand for these products; can the importers be traced and what are the interference implications?

Consideration should also be given to how the ECC can be more influential in the development of global harmonisation for these products during their development phase in the IEEE 802. It may be advantageous to set up a regular liaison between IEEE and ETSI, possibly to encourage these two organisations to strengthen a comprehensive MOU on SRDs facilitating, *inter alia*, the production of System Reference Documents for new products as soon as development begins.

8.9 Certainty of implementation of current framework

One of the shortcomings arising from leaving harmonisation to market forces is the certainty of implementation. While all parties may agree on a harmonisation measure, the speed of implementation will vary between Administrations, depending on a number of factors such as the degree of market pressure exerted within individual member countries and the need to protect the interests of incumbent users within those countries. Manufacturers when making investment decisions need certainty that markets will be available to their products. Similarly, they need some certainty about spectrum availability, both current and future.

8.10 A Comparison with FCC Regulations from the Industry's Perspective

Compared to the CEPT, the USA has the huge benefit of a single set of regulations applicable across the entire country (Federal Communications Commission (FCC) Part 15 Regulations[5]) and a single point, namely the FCC, from which to obtain them. On the downside, the very low effective radiated power (e.r.p) levels permitted by FCC, coupled with low duty cycles, are regarded as inferior to the situation of compatibility testing versus functionality as applied in the EU.

Most notably, the US made available 26 MHz of bandwidth in the Region 2 ISM Band between 902 – 928 MHz @ 1W conducted (4W e.i.r.p.) for generic spread spectrum SRDs as well as many HF and UHF frequency bands (with associated power limits) and other ISM frequency bands. This US rule enabled a "generic use and power limit" approach that is

[5] The FCC Regulations are covered in detail in Section 10.2

possible largely because of the large bandwidth (26 MHz) thanks to spectral density energy dispersion.

This contrasts with the situation in Europe where only 7 MHz bandwidth is available in the 863-870 MHz @ 25mW e.r.p. for generic spread spectrum SRDs but this spectrum is shared with many other narrowband/wideband SRD applications and radio services (e.g. those services used by the military) and thus constrains power levels here to a much lower level than is permitted in the US. This has resulted in the need for sub-band segmentation in Europe to ensure sharing compatibility different applications.

Compared with the US FCC Regulations industry opinion on the European requirement was divided in terms of market entry conditions. The FCC has a clear set of operating parameters and also requires a system akin to Type Approvals (similar to the previous procedure in the EU), considered by many to deter flooding of the market by inferior, imported products. On the other hand, the European approach to compatibility testing was regarded by industry as offering positive evidence of the likely success of the introduction of a new product or Class of product into a shared frequency band.

8.11 Conclusion on Current Regulatory Process

In this Section an analysis of the strengths and weaknesses of the current regulatory system regarding spectrum allocation for SRDs was presented. The current definition of SRDs was also identified as being adequate. It was acknowledged that there are a number of benefits of the current regulatory process but some disadvantages of the existing process were identified. Proposals for improvements to the future regulatory process for SRDs are outlined in the next Section.

9. The Future Short Range Device Regulatory Environment

This section takes into account the strengths and weaknesses of the current regulatory environment for SRDs, as identified in Section 7 of this Report and considers what changes to this regulatory procedure might be appropriate in the long term in the light of expected changes in society, technology and the use of these devices. Proposals for improving harmonisation and methods to increase flexible spectrum usage by Short Range Devices (SRDs) are also outlined.

9.1 The need for a strategic approach

Although this report focuses on SRDs, it would be wrong to consider them in isolation from radio services. To secure an optimal outcome, it is necessary to plan and manage the spectrum strategically as a whole. In deciding how best to meet growing demand from SRDs, it is essential also to take into account demand from radio services (and *vice versa*). This is because, although SRDs and radio services can frequently share spectrum and co-exist in the same frequency band, there are practical limits to the extent to which they can do so. For example, intensive use of SRDs in a shared band can raise the ambient noise levels within that band and compromise the quality of service delivered by radio services within it.

For example, intensive use of SRDs in a band can raise the noise floor and compromise the quality of service delivered by radio services, although these effects can be lessened by suitable mitigation techniques. Conversely, high-power transmissions from radio services in the same or adjacent bands can interfere with and block operation of SRDs, as evidenced for example by the effect of TETRA transmissions on radio car-locking systems when motorists were unable to unlock their cars in the vicinity of TETRA transmitters.

There is evidence of growing demand, which comes from an independent study in the UK[6], for spectrum below 15 GHz for radio services. For example, there is evidence that an additional 2.5 GHz could be required for cellular, terrestrial fixed links, broadband wireless access, satellite and terrestrial television broadcasting by 2025. In this case spectrum shortages are likely to be a constraint that could hold back innovation and growth to the detriment of European citizens and consumers. There is also evidence of growing demand for spectrum for SRDs. It is therefore important that both sets of services make more efficient use of spectrum and that full opportunity is taken of possibilities for sharing. Regulators can promote this by providing suitable incentives for spectrum efficiency and by making national spectrum management policies and European harmonisation more flexible.

Moreover, as discussed elsewhere in this report, once spectrum is designated to SRDs, it can be difficult and time-consuming to clear and re-farm it for radio services. This is because there is no record of the user base so it becomes difficult to inform users of the change and difficult to manage interference that might result. This means that it is necessary to undertake a careful analysis of the impact on other radio services of a decision to designate new spectrum to SRDs before proceeding. In particular, an opportunity benefit analysis in terms of access denied to alternative applications may be useful.

As remarked elsewhere in this Report, growing use is being made by several administrations of market mechanisms in managing radio spectrum. Applying market mechanisms to spectrum for SRDs is problematic because there tends to be no single user body to acquire the spectrum and a lack of a mechanism to charge users to access the spectrum. In principle, such charges may be gathered through a royalty payment included in the purchase price of the SRD devices at point of sale. However, this appears to be impracticable from the management point of view, also because it is highly doubtful that there is an effective way to prevent unauthorised access by other devices.

Further to note is that the Directive 2002/20/EC (Authorisation Directive) states that "non-applicability in case of the self-use of radio terminal equipment, based on the non-exclusive use of specific radio frequencies by a user not related to an economic activity, normally for remuneration, intended for provision of an electronic communications network or service." The Directive 2002/20/EC further states that "such use is covered by the Directive 1999/5/EC on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity." Member States may therefore restrict the putting into service of SRD radio equipment only for reasons related to the effective and appropriate use of the radio spectrum, avoidance of harmful interference or matters relating to public health. It is therefore clear that money cannot be gathered from SRD spectrum because it does not fall within the "Authorisation Directive".

[6] http://www.spectrumaudit.org.uk/pdf/spectrum_demand.pdf

In the absence of a market mechanism, it will continue to be necessary for regulators to designate spectrum to SRDs by administrative and regulatory means. For reasons discussed elsewhere in this Report, it may be beneficial to do this on a harmonised basis as long as the harmonisation is not excessively restrictive and technical and other constraints are kept to the minimum that can be justified and is necessary.

9.2 Improving the SRD regulatory mechanisms

The present system has evolved over a period of many years but is now showing signs of age. Traditionally, spectrum bands for SRDs have been determined on the basis of the nature of the device and particular propagation requirements. These bands would then be sub-divided into further sub-bands to ensure that devices would be operating with other SRDs with broadly the same technical characteristics and sometimes providing a similar service. International user mobility was less of an issue so harmonisation did not have the priority it now has. The number of devices manufactured was also considerably less than today so the statistical likelihood of interference was lower. Devices produced in this environment had to pay little regard to the bandwidth for either the transmitter or the receiver.

The situation today is considerably different. The number of devices available in both the industrial and domestic environments has shown a very high rate of growth and this has imposed strain on the regulatory environment. A more mobile population within an enlarged EU has increased demand for devices that can be freely taken and used across national frontiers. The EC, recognising these pressures and accepting that these devices are mass-market items, has taken action to ensure the removal of as many of the barriers to trade as possible.

A further factor in today's SRD environment is the high number of devices appearing on the market from outside of Europe. Increasingly small independent SRD equipment manufacturers are using chip-sets provided by large global companies to provide their radio solutions. This has led to the market being driven by chip-set vendors mainly active within the IEEE 802 LAN/MAN Standards Committee which is looking for a global radio solution based primarily on FCC allocations. While many of these comply with European spectrum allocations, a number do not. With many products now being marketed through the Internet, it is becoming very difficult to take action against the manufacturers or distributors. In some cases, damage-limitation measures must be considered - the recent action to develop an acceptable specification for Band II SRDs and interim arrangements for 5 GHz RLANs in response to consumer-led demand are examples of this.

The CEPT needs to be more aware of market trends outside of Europe and to improve its strategy for dealing with, and influencing, any spectrum demands that might arise from this. Developing an awareness of what is happening elsewhere in the world such as in the FCC or in standardisation organisations such as the IEEE would be another. However, in considering this demand, the first step should always be to look at accommodating this demand within existing SRD spectrum. Any claims of spectrum saturation need to be supported by evidence. It must be recognised that, in some cases, CEPT alignment with spectrum allocations available elsewhere in the world is going to be very difficult and may need to be looked at on a global basis – implementing the FCC allocation at 902-928 MHz for example.

There is a need to change public perceptions. Users must realise that the operation of increasing numbers of transmitters within the home or business premises must bring with it the increasing possibility of interference. In many cases, these can be simply resolved by increasing the physical distance between these devices.

Industry also has a part to play. Spectrum, particularly at VHF/UHF, is a scarce commodity for which licensed/higher-power users are prepared to pay significant sums. Designation of a band for SRDs may limit the use that may be made of it by licensed services but this needs to be balanced against the wider social and economic benefits that may flow from the SRD use – for instance, the incorporation of these devices into a variety of medical, domestic and industrial applications. This process is likely to be time-consuming and extremely difficult in practice to clear spectrum of SRDs if it is later decided that it would be preferable to introduce licensed services in the band in question. All of the effects on licensed/higher-power users need to be taken into account in any assessment of the benefits of new spectrum allocations to SRDs.

There is a need to ensure that existing SRD spectrum is used optimally and does not hold back innovation. There are a number of new technologies that can be considered to facilitate greater sharing and some of these are listed in Annex 2 to this Report. It would be advantageous in appropriate cases to relax technology and application constraints in harmonisation measures where this can be done without unduly affecting licensed services operating in the same or adjacent bands or certain critical SRD applications. Removal of unnecessarily restrictive constraints will facilitate access to spectrum by innovative applications and, by reducing fragmentation of the spectrum available for SRDs, enhance spectrum efficiency. However it is possible that some segmentation, possibly based on duty-cycle and/or characteristics of deployment, will still be required for effective use.

The current procedure for identifying new SRD spectrum is described in Section 8.

9.3 Methods to improve harmonisation

In looking at harmonisation of SRDs a number of factors need to be taken into account. Most types of SRD are licence free, low-cost, mass-produced consumer items that are portable and for certain types of SRD, users tend to take with them to use in different countries. This makes enforcement against unauthorised SRDs a problem for the regulatory authorities. Some products such as Radio Frequency IDentification (RFID) and AIMD/ULP-AMI devices need to be able to operate on a global basis, though there is some flexibility in the frequencies used by the RFID interrogators but not for the ULP-AMI – P, e.g. programmers. Some SRDs form part of larger capital goods – car keys, vehicle immobilisers etc. A particular case of this is the new generation of human implantable devices such as heart pacemakers which can be programmed by radio. In this case, since these devices tend to be located in a medical facility there is some flexibility over the frequencies available to the programmer, although it can be seen that it would be undesirable for the implanted device to be falsely triggered by other radio systems using the same channel(s).

Many SRD equipment manufacturers are using chips-sets provided by large global companies to provide their radio solutions. This has led to the market tendency being driven by companies looking for global markets.

9.3.1 Short term

In the short term, the market drives harmonisation. For the reasons set out in Section 6, there is pressure from both industry and consumers to harmonise SRD spectrum designations . This harmonisation process has so far worked fairly well but could be improved. In particular, there are no disincentives for those requesting harmonised spectrum, possibly speculatively, if the level of use does not reach predictions.

9.3.2 Mid to long term

In the medium term, harmonisation could be improved by developing the SRD environment to ensure that it has the necessary minimum of regulation. Excessive regulation imposes costs on business, stifles innovation and provides a barrier to market entry.

One area of investigation is the removal of unnecessary burden by reducing as many of the application-specific constraints to spectrum use as possible. Ensuring sharing compatibility between different applications or technologies (technology neutrality) is necessary to grant reasonable operational reliability and to maintain SRD market credibility.

This will also enhance spectrum efficiency as it will open the possibility that a wider variety of SRDs will be accommodated in existing SRD bands without the need to set aside additional spectrum. The natural tendency to seek to provide explicitly for national or international policies or priorities should be resisted in favour of greater application neutrality.

9.4 Role of market forces in harmonising spectrum for SRDs

The use of market mechanisms, such as spectrum pricing and secondary trading, to manage radio spectrum opens up the possibility of market-led harmonisation, in which harmonisation is determined by market players rather than imposed by regulators. Where harmonisation offers economic or market advantages, operators or users can be expected to acquire spectrum through the market for the application in question, leading to de facto (as opposed to de jure) harmonisation. However, the application of these market mechanisms to harmonising the availability of spectrum for SRDs is extremely difficult. In part this is because the SRD market is split between manufacturers, whose interest is in selling products, and individual users, who wish to operate the products they have bought.

Where SRDs are subject to general authorisations-free use rather than individual licensing, it is difficult for participants to join together to acquire spectrum through the spectrum market or to arrange for a “band manager” to do this on their collective behalf. In the particular circumstances of SRDs, it is difficult for market mechanisms to distribute appropriately applications or technologies between available bands in an effective manner. Hence, for the present at least, regulators need to decide on the appropriate amount of harmonised spectrum to be made available for SRDs through general authorisation-free use, and to some extent, set conditions under which it can be used.

It is also noted that for SRDs the manufacturing industry represents the sole available source of information on market needs because, with very few exceptions, there are no SRD users’ associations. This contrasts with other radicommunication services where users/operators play the major role in providing information to help the decisional process (i.e. cellular mobile, maritime, aeronautical, broadcasting, satellite, etc.).

Therefore, as noted elsewhere, provision of spectrum for SRDs has evolved in part based on manufacturers' requests, and on resulting compatibility assessments. It is perhaps appropriate now to review this position, where possible. This with the aim of relaxing constraints where practical, to provide the market with greater freedoms to address user demand, while remaining within an appropriate spectrum management framework. See Section 8 paragraph: “Is Recommendation 70-03 generic enough?” and Annex 4 for more information.

9.5 Evolution or revolution of the present framework

The views of industry support evolution of the present framework. Revolution brings uncertainty that, in turn, has an adverse effect on the level of investment companies are prepared to make in new products. This suggests that a four-pronged approach is needed –

a) to eliminate unnecessary regulation in the present SRD environment and minimise the number of application-specific Annexes in Recommendation 70-03, where appropriate while being less reliant on frequency separation as a method of avoiding interference.

b) for CEPT to encourage the introduction of technologies or other techniques into SRDs to minimise any interference caused to other radio systems – both licensed and exempted from individual licensing, and to ensure that applications remain viable despite unpredictable future spectrum use. Annex 3 lists some technology solutions that could be used to enable greater sharing by SRDs in order to reduce any demand for new/additional spectrum.

c) to put into place procedures for critically assessing any proposals for SRDs to access new spectrum. The assessment will need to consider the implicit costs of accessing new spectrum and make a comparison against the benefits that would flow from using that spectrum for other purposes, including those not involving SRDs. This assessment should take into account a number of factors including –

- The investments that incumbent users will already have made in the target spectrum
- A recognition that spectrum has a value and there will be opportunity costs[7] associated with moving into spectrum not previously occupied by SRDs.

d) to consider how best any ongoing controls should be applied to SRDs – for example while it might be appropriate to relax the types of SRD applications permitted in a band, it might remain necessary for operational or compatibility reasons to limit use in certain environments (e.g. outdoors), to avoid consumer-based, portable equipment (e.g. mix meter reading, building automation and alarms, but avoid radiomicrophones) or to retain some technology limits e.g. duty cycles.

It is recognised that applying a more comprehensive analysis to the demands for new spectrum allocations will add some delay into the process but there is a need to ensure that decisions such as these are properly thought through. It can be both difficult and time-consuming to reverse ill-thought out decisions because of the difficulties associated with the need to provide some protection for legacy SRDs which, because of their unlicensed nature, are almost untraceable.

Greater flexibility can also be provided by the removal of, where appropriate, the individual ERC/ECC Decisions for SRDs. As these were produced for bands that were already fully harmonised, they have done little to further the harmonisation process and serve only to stifle change to the SRD regulatory environment. The EC's development of a SRD Framework

7. Opportunity cost is the value of what is given up as a result of a decision. For example, a decision to allocate a frequency band to one application may mean that it cannot be used for another. The opportunity cost of that decision would be the total value of the benefits, including social, that the second application would have generated and that have been foregone.

Decision may undermine the usefulness the individual ERC/ECC Decisions for SRDs may once have had.

9.6 Role of EC Framework Decision for SRDs

The role of the EC Framework Decision is to provide EU-wide legal certainty for equipment relying on the provisions of ERC Rec 70-03. It will also provide a single point of reference to industry on harmonised frequencies available within the EU for SRDs. It is important that any modifications to this regulatory environment are made in a transparent and non-discriminatory fashion.

The future role of the ECC (SRD Maintenance Group) is seen to be crucial in working in co-ordination with the Commission to ensure that ERC Rec 70-03 and the provisions of this Framework Decision are brought into alignment. The efficiency of the collaboration between these two bodies will be an important factor in ensuring that the justified needs of industry are met in as speedy a fashion as possible and for meeting EU policy objectives.

9.7 Increasing flexibility in spectrum use

9.7.1 Generic limits for all spectrum

One of the features of spectrum use in a number of countries outside of the CEPT is the application of a general power and/or power density limit below which use by SRDs is taken out of the usual regulatory process. Details on this are provided in Section 10 of this report. It is a conclusion of this Report that CEPT be tasked to investigate the possibility of developing such a limit for CEPT countries. In developing this proposal, it is recognised that it will not be a blanket limit applied across the spectrum but will vary with frequency and propagation features.

It is also recognised that there will be problems to be overcome when considering bands containing sensitive applications, particularly those protected by ITU-RR footnote 5.340, or those with direct safety-of-life implications. This work will also need to take into account the work being carried out on the development of a position on Ultra Wide Band. In setting a general level below which use of SRDs could be effectively deregulated, it would be desirable to take account of similar limits that have been adopted in other parts of the world, while recognising that it may be necessary to adapt the level in order to suit conditions in Europe.

In setting a generic limit, CEPT must be mindful to ensure that it introduces as little a barrier to technologies and applications as possible. It may therefore be pragmatic for CEPT to describe the generic limit in more than one way in many frequency bands, to ensure technology neutrality. Such multiple descriptions of technical parameters already exist in ERC/REC 70-03 in the same frequency band.

In addition, there is a need for consideration of possible generic low power limits across the spectrum. In the same way that there will be troughs to protect sensitive allocations, there can be chimneys where spectrum use is less sensitive, for example, ISM bands.

These general limits can be used to introduce a new class of SRDs. This might be called “Ultra Low Power narrow and wide band for very short range SRD applications.”

Ultra Low Power (as opposed to Ultra Wideband) levels of radiated power are applied commonly in SRDs used for medical applications. Additionally there is some demand for non-medical ULP-SRDs, with a general relaxation of the regulations governing "conventional" SRDs e.g. the recent case of inductive SRDs.

A generic ULP-SRD concept, if proved technically viable, may in principle relieve some of the pressure from "non-ULP SRD spectrum" because this may satisfy those applications that require only very short range.

Based on this concept there is a reasonable case to define such devices as Class 1 for use across the EU and other countries that have implemented the R&TTE Directive. However, there is reason for caution since conventional SRDs may experience a reduction in range in the presence of ULP devices due to an increase in the noise floor. CEPT should be requested to commission the necessary feasibility studies.

The ULP-SRD would be achieved by the definition of generic masks. The maximum level of those masks should, by definition, be very low and should afford protection to other radiocommunication applications/services. Although the masks may not guarantee any protection for the ULP-SRDs, they may ensure spectrum compatibility between ULP-SRDs and different conventional SRD applications sharing the same spectrum. This to secure reasonably reliable operation for both.

Important examples of ULP-SRD have been recently introduced for very close proximity inductive applications and for ULP wireless audio in Broadcasting Band II (see ERC/REC 70-03 Annex 9 and Annex 12 respectively).

ECC Report 67 contains an example of such limits for extremely short range applications in the frequency band below 30 MHz.

The regulatory framework under discussion for UWB covers all types of wide band SRD applications between 30 MHz and 10.6 GHz. The spectrum mask referred to in ECC Report 64 might also apply to ULP narrow band SRD applications.

Considering that a lot of radiocommunication applications/services have to be taken into account, it is recommended to investigate as a first step the frequency bands where it is expected the SRD transmitter mask should be high enough to authorise the development of new Ultra Low Power SRD applications.

It should be noted that the manufacturer may choose the specific mitigation techniques (modulation schemes such as spread spectrum, duty cycle, LBT, SDR, indoor/outdoor etc…) to increase the protection of the SRD from other radiocommunication applications/services. The effectiveness of these mitigation techniques may lead to a relaxation of the maximum level of the ULP-SRD mask.

9.7.2 Access to existing SRD spectrum

A conclusion of the Report from CEPT to the European Commission to the first Mandate (CEPT Report 005 - Conclusion 7) was that manufacturers, in considering the spectrum requirements for new products, should first look at the bands that already exist for SRDs. These are listed in ERC/REC 70-03. Any collective request received by CEPT for change to the application-specific Annexes to this Recommendation should be looked at sympathetically, recognising that most frequency bands mentioned in Rec.70-03 are already generic (see section 8.3 of this Report). CEPT should be further encouraged to make these Annexes more generic, where possible, to permit the widest use of scarce spectrum resources.

An efficient approach is to encourage greater use of existing allocations by extending the scope of specific applications. Allowing applications to spread over several bands would even out occupancy, and reduce the overall demand for spectrum. More critical applications, e.g. social alarms, fire & security alarms, wireless applications in healthcare, railway management, model control etc. may still require application-specific bands.

9.7.3 Additional SRD spectrum

9.7.3.1 Extension bands (for existing and future applications)

Should the market prediction figures given in this Report be realised, some congestion might be expected. However, this situation is by no means certain and the effects may be lessened by the use of new technologies such as LBT and/or AFA. At present, the only band in which LBT and/or AFA is introduced is 863–870 MHz. Once operational experience has demonstrated the benefits of these techniques consideration should be given to its general introduction to all suitable existing SRD bands. Introduction of LBT and/or AFA in existing SRD bands is a first priority. However, any benefit from the introduction of LBT and/or AFA may be short lived if the anticipated growth in SRDs occurs. Therefore the identification of new spectrum for SRDs employing these techniques is a second priority.

New bands should preferably be extensions of existing SRD bands or close to them. Other bands could be considered dependent upon on the robustness of the primary occupants. For example, access to the broadcast bands; particularly “Band V”, has already been identified in various European fora. Clearly, such an introduction should, in no way, prejudice the Broadcast services. A contribution on this is given in Annex 5 to this report.

The main problems with identifying additional spectrum for SRD applications are the uncertainty over the degree of success the application will have the technical characteristics of the equipment, and prioritising the SRD demand against alternative uses. There is reluctance by some administrations to set aside spectrum on a speculative basis against possible future demand. However manufacturers require some degree of certainty in terms of spectrum availability in order to fund, develop and produce equipment.

For example, the radio microphone allocation at 1785-1800 MHz has lain unused for many years in anticipation of the development of digital products. This demonstrates how speculative allocations can lead to under-use of valuable spectrum and the denial of spectrum to other services that could have generated substantial benefits for businesses and consumers.

On the other hand, it has to be recognised that the information as collected by this Report has shown success for most of SRD applications, as regulated by ERC/REC 70-03, also in term of market size. The continuous SRD/MG updating process of ERC/REC 70-03 can be improved by carrying out a periodical general review and assessments of trends on existing SRD applications and future demand for spectrum.

CEPT has hitherto not made spectrum available in a staged or milestone process for SRDs and while this would reduce the amount of underused spectrum, such identification would in the meantime limit the value and alternative uses of that spectrum. With a reasonable spread of success between applications and bands, some bands would be expected to be near saturation, while others would have significant room for further occupancy.

9.7.3.2 Feasibility of spectrum above 40 GHz for SRD applications

Because SRDs, by definition, operate over short distances, propagation characteristics are less critical than for radio services, which may provide service over distances of tens or hundreds of kms. Given that radio services are, with current technology, effectively confined to frequencies below about 30 GHz, it follows that any new allocations for SRDs should, theoretically speaking, be made at frequencies above about 40 GHz because these higher frequencies are less likely to be congested because they are less in demand for radio services, can be re-used more intensively and offer greater bandwidth.

Although frequencies above 40 GHz seem on one hand inherently more suitable some difficult questions arise which are –

> a) Is semiconductor technology that can be used at these high frequencies available today? If not, will it be in the future and if so, when? Doubts are serious because today the known semiconductor physical cut-off is 30-35 GHz; it therefore seems unlikely to reach SRD compatibly at a reasonable cost in the foreseeable future.
>
> b) Currently there is no available information on components for these frequencies.
> It is clear that there are no solutions which can compete with today's single chip transceiver at 865 MHz or 2.45 GHz. However, these chips may be evaluated as the back-end of microwave SRD equipment.
>
> c) The current power consumption may exclude any battery operated equipment; this is contrary to most SRD markets that require long life (>5 years) battery operated devices. Is it possible to overcome this issue?
>
> d) For what SRD applications will these frequencies be suitable?
> Above 40 GHz the propagation physics, design and high power requirements may certainly confine applications within extremely short links of few metres, or decades? This is also contrary to the most of SRD markets that require “concrete wall” penetration that cannot be physically overcome; even if studies may positively shows the possibility for a medium gain antenna with horizontal omnidirectional pattern.

The considerations above lead to the conclusion that SRDs operating above 40 GHz are not the sole solution for the future of SRDs. It may be one opportunity covering some SRD market applications. Nevertheless this has to be seen as a possible long-term exploration that certainly, if launched, will require close Regulators’ cooperation with Industry and ETSI.

9.7.4 The possibility of global harmonisation to be based on new WRC decisions (WRC-10)

As mentioned in chapter 10.1 short range devices are recognised within the ITU-R in Recommendation SM. 1538 “Technical and operating parameters and spectrum requirements for short-range radiocommunication devices” which is subject to revisions on a regularly basis according to updated information available.

It is important to note that this ITU Recommendation is just a compilation of technical and operating parameters as they are in use within some countries or ITU regions.

ETSI believes that there is also a need for a regulatory ITU deliverable in order to promote / strengthen the European strategic moves on SRDs by means of spectrum harmonization by ITU, preferentially on a global basis but at least on a regional basis.

Therefore ETSI submitted CPG in January 2005 a proposal for WRC-07 agenda item 7.2 containing a draft proposal for an agenda item for WRC-10 "to consider regulatory frameworks to facilitate the introduction of new technologies used in short-range radiocommunication devices (SRDs), while ensuring that the operation of existing radiocommunication services is not adversely affected".

The expected result should be the identification of some frequency bands, outside ISM bands and/or frequency tuning range to be used by SRDs without giving the status of a radiocommunication service to these applications. This will allow Administrations to determine as appropriate, given their national conditions and requirements, how much spectrum and where within the frequency tuning range it can be made available at a national level.

9.7.4.1 Technical Background that may support the above goal

High-efficiency, polite spectrum-sharing methods for SRDs, such as LBT, AFA, and Spread Spectrum, have been recently introduced in Europe, especially in the 863-870 MHz band, supported by CEPT/ERC Recommendation 70-03 Annexes 1 and 11.

This is an important step in technology, which may be introduced together with competitive on-board chipsets for Short Range Devices. A further step might be to associate it, to some extent, with Software Defined Radio and Cognitive Radio solutions. As a result, this type of device might be capable of transmitting outside of the assigned CEPT frequency bands but should transmit only within CEPT bands when in use in CEPT countries.

Currently in the US there is already a visible trend: two years ago US introduced the regulatory "Cognitive Radio" concept.

Considering all of the above, the most crystal clear example comes from the fact that the CEPT "860 MHz" and USA "900 MHz" are quite close to each other, it seems as if there is a significant potential for some ITU "SRD globalisation".

This would promote/strengthen the world strategic moves on SRDs by means of spectrum tuning range(s) identified by the ITU, preferably on a global basis but at least through harmonisation on a regional basis, thus promoting CEPT/ERC Rec. 70-03, in particular Annexes 1 and 11 and regulations on LBT/AFA. Achieving this goal will reduce the level of non-compliant equipment entering the European market and facilitate the *(type approval)* Mutual Recognition Agreements (see 1999/5/EC, R&TTE Directive).
In order to reach this goal, there is a need for a regulatory ITU deliverable (possibly a Recommendation incorporated by reference in Article 5 or a Resolution) because the Recommendation ITU-R S.M. 1538 only focuses on the technical and operational parameters of existing and new SRDs.

9.7.5 A regulatory process for SRDs

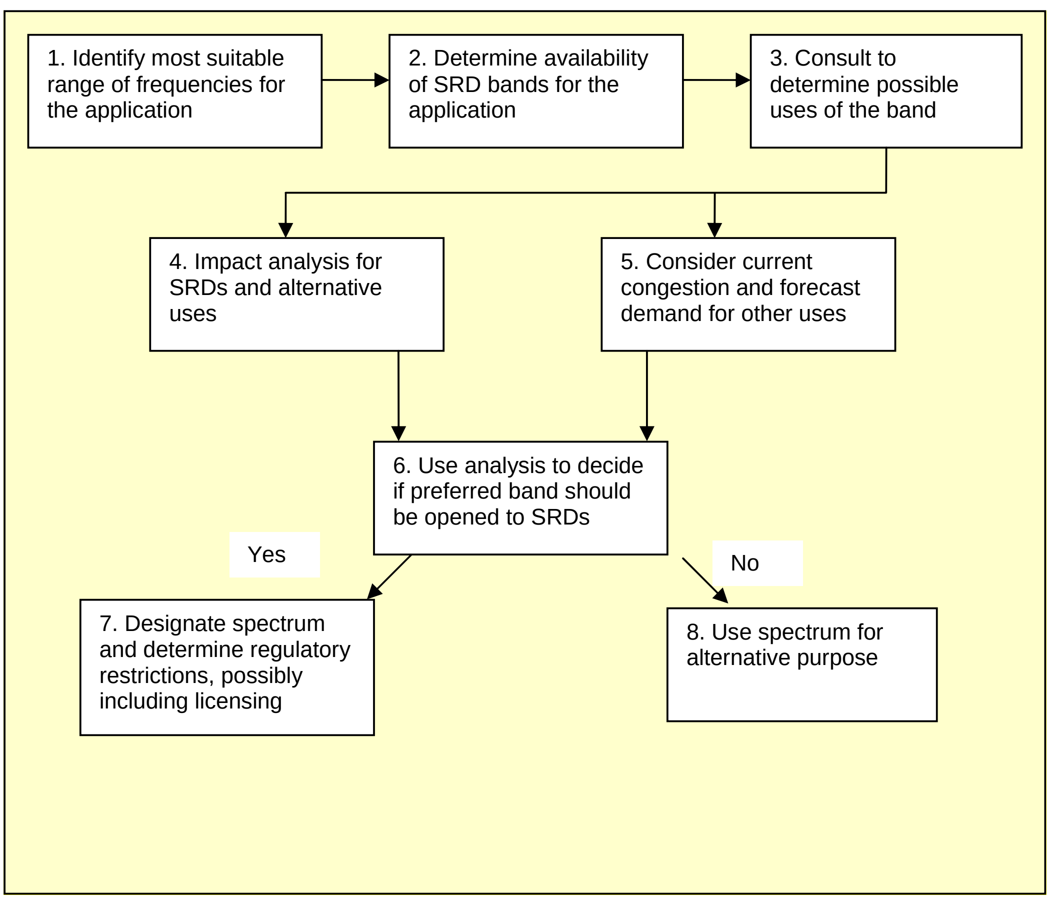
Any regulatory intervention requires judgments and trade-offs to be made by the regulator. The following is suggested as a framework for regulatory decisions on SRD spectrum. It will generally facilitate the process if equipment manufacturers are given information on future SRD strategy so that they can design future devices around availability of spectrum and incorporate this information at an early stage of product development. This may require improved dialogue between manufacturers and spectrum managers.

The four key stages of the proposed regulatory process may be summarised as follows.

- Identify most suitable range of frequencies for the application.
- Determine availability of SRD bands for the application.
- Determine the most likely use of the band.
- On the assumption that SRD use should generally be licence-exempt, decide whether, in this instance, there is any basis for the individual licensing of SRDs.
    - If designated for licence-exempt SRD use, determine the regulatory restrictions that should apply.

This is illustrated in the following diagram.

Figure 4: Proposed regulatory process



The main stages in this process are discussed in more detail below.

1. Consultation (Box 3 in Figure 4)

Consultation on the use of spectrum is already widely used. Although potential users of licence-exempt spectrum may be unlikely to respond to a consultation, manufacturers of devices which use such spectrum might. A specific question on the consultation document asking about licence-exempt usage might yield important information to support regulatory decisions.

2. Consider current congestion and forecast demand for other uses (Box 5 in Figure 4)

As suggested above, it is necessary to consider patterns of current congestion and expected future demand for both radio services and SRDs. It may be possible to draw inferences from nearby bands or related applications. For example, if a potential use for a particular band is for terrestrial fixed links and a neighbouring band that has already been allocated for fixed links is under-used, that would tend to imply that it is unnecessary to allocate more spectrum to fixed links. If, on the other hand, usage by SRDs is growing rapidly elsewhere in the spectrum, this would indicate that it might be appropriate to designate the band to SRDs. Where demand is expected to grow from both SRDs and radio services, it will be necessary to consider which would be likely to generate greater benefit, taking account of both commercial value and social benefits.

There is a wide divergence of views on the optimal balance between SRDs and radio services, ranging at one extreme from those who consider that spectrum shortage would be eliminated if all spectrum were set aside for SRDs and devices were sufficiently intelligent, to the other, which considers that all spectrum should be licensed with arrangements for licensees to grant access to others who might not hold a licence. Having an understanding of the demand for short-range communications enables an upper limit to be placed on the amount of spectrum required for SRDs. It has been estimated, for example, that a total of 800 MHz should be sufficient in urban areas for SRD applications[8] (other than Short Range Radar at 24 GHz, 76 GHz and 79 GHz) that may be foreseen over the next 5-10 years. This is based on an assumption that 100 Mbits/s per person should be adequate and taking into account the frequency re-use possibilities in urban environments. This estimate is tentative and does not cover the full range of SRD applications but serves as an example of the potential of this approach that could be refined to produce more robust predictions.

It does not however imply that it would be optimal to allocate the entire 800MHz estimate as spectrum for SRDs. That judgment would require an impact analysis as outlined below.

3. Impact analysis (Box 4 in Figure 4)

The optimum allocation of spectrum would be the one that resulted in the greatest value in terms of both commercial and wider social considerations. In the absence of market mechanisms, it will be necessary for regulators to attempt to predict the value of each of the different plausible uses and then to favour the use with the highest expected value, taking account of both commercial value and wider social benefits. The latter might not be readily quantifiable but assessing the foregone commercial value will aid rational decision-making

[8] see http://www.ofcom.org.uk/consult/condocs/sfr/sfr2/sfr.pdf

by making transparent the cost of achieving the particular public policy objective in question. Proceeding in ignorance of the commercial cost of public policy is unlikely to result in a well-informed decision that best serves the wider public interest.

Limitations on data availability and accuracy of forecasting mean that forecasting opportunity costs will inevitably be subject to uncertainty. However, they can still aid regulators to reach rational decisions on the optimal use of the spectrum. Sensitivity analysis can assist in these circumstances by enabling regulators to test conclusions against a range of assumptions. If a particular conclusion holds across a wide range of assumptions, it may be regarded with a fair degree of confidence.

4. Select preferred use of band (Box 6 in Figure 4)

This step will draw on the results of the previous stages. Note that the analysis should also take into account the availability of other suitable spectrum. If SRDs may be situated at higher frequencies that are unsuitable for radio services, this will generally be preferable to allocating to SRDs spectrum that could also be used by other radio services. Based on the processes outlined above, the regulator should be able to come to a conclusion as to the most likely use or uses for the band and whether the band should be allocated to SRDs and/or radio services.

Generally speaking, spectrum should be subject to licensing if any of the following hold true.

1. The band is likely to be congested. A way to approximate for this is to assume that congestion would occur if the application would serve an area within a radius of about 1 km. Cellular and broadcasting are examples of such services.

2. A guaranteed quality of service (QoS) is needed. This is the case, for example, with most public safety communications.

3. International treaty obligations impose restrictions that would be breached by operation on a licence-exempt basis either now or at some known point in the future.

Each of these points is considered in more detail below.

4.1 Potential interference area and the likelihood of congestion

SRDs generally transmit at a low power. As a result, the area that they interfere over is small, reducing the probability that there will be another user in the same area. In general, the lower the power of SRDs the lower the likelihood of interference. Restricting the potential area of interference too much would significantly reduce the attractiveness while having too much power may cause unacceptable interference. Therefore, the operation of SRDs should be restricted to transmitter powers that are just enough to meet the requirements of the application.

4.2 Quality of service

It is not possible to guarantee the interference levels that will be experienced by SRDs from other SRD devices in the same band. The limit on transmitter power will reduce the likelihood of interference but the incidence of interference will depend also on the density of devices (aggregate interference), which cannot be controlled. Therefore, SRDs are generally unsuitable for communications that require a prescribed quality of service in terms of maximum call waiting times or a given level of freedom from technical interference.

4.3 International treaty obligations

Most spectrum band allocations are agreed at an international level. In some cases, this restricts the ability of an individual administration to change the allocation. In general, a redesignation of spectrum for SRDs would be unlikely to generate interference in other countries because of the low power levels associated with their use. However, because of the difficulty of reclaiming SRD bands, they should not be designated to SRDs if an international obligation is expected to require it to be reallocated in the future to a radio service that could not co-exist with the SRD usage.

5. Determining regulatory restrictions (for SRDs) (Box 7 in Figure 4)

If a band is to be designated to SRDs, the regulator will need to decide what restrictions to impose on their use and judge the most appropriate level of restriction. These restrictions should be kept to the minimum necessary to avoid harmful interference. There may be a case for restricting certain SRD bands to application-specific SRDs. In considering the risk of interference, it may be pertinent to consider the likelihood of the risk of congestion: the greater this risk, the more justification there is for imposing restrictions e.g. based on duty cycle requirements.

However, it is necessary to carry out an impact analysis of any proposed restrictions to ensure that they are justified and proportionate given the expectations and requirements of the SRD users, the seriousness of the consequences of any interference and the ease with which interference might be remedied. For example, if consumers can avoid interference easily by increasing the separation distance between devices, it would be disproportionate to impose regulatory restrictions. Similarly, if imposing mitigation techniques would have minimal impact on the device cost then they might be used without hesitation but, if such techniques would significantly increase device cost and congestion is unlikely, or would have little impact if it did occur, then they should not be imposed.

It is relevant to note that the quality of the receivers in SRDs will affect their propensity to be affected by interference and hence their potential to share with other SRDs and with radio services. Decisions imposed on other services sharing with SRDs therefore implicitly take account of the SRD receiver quality. There is thus a trade-off, which can in principle be quantified, between the additional unit cost of better quality receivers and the benefits that result from more intensive use of the spectrum. This could be factored into decisions on technical restrictions on the transmitter side that are imposed in general authorisations on SRD use and in individual licences on radio services. Restrictions imposed on transmissions should be based on the quality of receiver that provides the optimal balance.

9.7.6 Review

The regulatory process should be repeated periodically and decisions reviewed. Where appropriate, the regulatory process should be revised and if necessary decisions changed or abrogated in the light of changes in market demand and also technological progress, which may enable restrictions on spectrum use to be relaxed. If a frequency band remains unused and there is demand from other services, consideration should be given to refarming it to meet that demand. This review process should be pro-active. The CEPT already has rules of procedures in place that require review at least every three years which should include an appraisal of the regulatory process.

10 Best practices applied outside ITU-Region 1

In this section a review of the effectiveness of best practices applied outside of the EU is presented.

10.1 ITU-R Recommendation SM.1538-1

As early as in 1993 ITU-R Study Group 1 decided to study the spectrum management aspects of Short Range Communication Systems by adopting Question ITU-R 201/1 ”Spectrum management aspects of short range communication systems”.
This Question ought to result in a recommendation. The recommendation should deal, inter alia, with technical questions like modulation, access techniques, protocols, etc related to spectrum efficiency of short range systems, should address sharing techniques to avoid harmful interference between short-range systems, and asked for frequency ranges which are particularly suitable for short range systems with various operational parameters in various environments.

Until 1997 the response to this Question was nil and not a single contribution was received to begin the work. Therefore ITU-R Study Group 1 started in 1997 a new attempt to address this topic by adopting the new Question ITU-R 213/1 “Technical and operating parameters and spectrum requirements for short range devices”. Question ITU-R 201/1 was abrogated.

This new Question again aimed at studies of technical and operating parameters for Short Range Devices (SRDs) as well as identifying frequency bands and spectrum requirements for reasonably unrestricted global access for SRDs.

However, in taking up the drafting of the new recommendation it soon became obvious that the differences between the three ITU Regions in handling SRDs were so significant in terms of frequency assignments, technical and operating parameters that a global solution could not be found.

Hence, it was decided to develop a recommendation which consists of a common part describing the SRD applications and the commonly used frequency ranges (which are mainly the ISM bands according to RR Nos. 5.138 and 5.150) and a number of appendices in which the regulations for SRDs for regions or countries are explained.

This Recommendation, ITU-R SM.1538 “Technical and operating parameters and spectrum requirements for short-range radiocommunication devices”, was first adopted in 2001 and is subject to revisions on a regular basis according to updated information available.

Currently the Recommendation includes the provisions stipulated for the CEPT countries, the United States of America and Canada, the People’s Republic of China, Japan and Korea. The following conclusions on the regulatory situation in other countries outside Europe are partly based on information taken from Recommendation ITU-R SM.1538. Details are given in Annex 3.

10.2 FCC rules for legal low-power, non-licensed transmitters

The advantages and disadvantages of the FCC rules for SRDs are as follows:

Advantages of the FCC rules

1. The manufacturer has a much wider choice of spectrum than in Europe.
2. Clear technical limits show the operating parameters which the manufacturer can achieve for equipment operating in any part of the spectrum.
3. The FCC approval of the equipment provides the manufacturer with a 'right' that will not be challenged by market surveillance, unless the equipment causes interference.
4. Where the regulation allows the general limits to be used the manufacturer has greater flexibility to use a frequency range optimal for the application.
5. By using the whole spectrum allocation the density of devices in any part of the spectrum may be reduced.
6. The FCC has removed the majority of the licensing and spectrum planning process for the devices covered by Part 15, making equipment easier to use for the end user.
7. The FCC may change the rules at short notice according to technical or market developments.

Disadvantages with the FCC rules

1. Part 15 is a complex document which requires intensive study to be understood in full.
2. Third party testing of equipment is mandatory.
3. Equipment testing and the approval process for certification or verification are time consuming.
4. Whilst the emission limits have been chosen to minimise interference, the proximity of different technologies in an enclosed space such as an office can result in a reduced service to the user.
5. No spectrum planning will be executed in the same manner as is the case with ERC/REC 70-03 which aims to maximise compatibility of equipment within the same allocation.
6. The uncertainty of whether the FCC could change the rules at short notice may prevent manufacturers from investing in new applications.

In summary

- In Europe extensive sharing studies will be carried out prior to any designation of new bands for SRD applications but this ultimately reduces the potential for interference between applications and services.
- It is relatively easy to place equipment onto the European market.
- The USA has numerous frequency bands available for SRDs. However, they tend to be shared with other licensed services which must be protected.
- In the USA, a mandatory type approval procedure must be followed and equipment must be authorised by the FCC before it can be placed on the market there.

10.3 Regulations for SRDs in China

An assessment of the Chinese regulations leads to the following conclusions:

- The Chinese regulations do not include provisions for general field strength or power limits.
- For general SRDs the maximum field strength for all frequency bands, except the "ISM bands", is very low.
- The frequency bands designated for SRDs are not in accordance with the European regulations.
- Type approval performed by the Ministry of Information Industry of China is mandatory.

10.4 Japanese requirements for low-power, non-licensed radio equipment

An assessment of the Japanese regulations leads to the following conclusions:

- The Japanese regulations specify general limits, which vary according to frequency, for extremely low power stations.
- The frequency bands designated for SRDs in Japan in general are not in accordance with the European regulations with the exception of WLAN, RFID and RTTT.
- Type approval according to the technical characteristics as specified by MIC is mandatory.

10.5 Requirements for low-power radio stations in Korea

An assessment of the Korean regulations leads to the following conclusions:

- The Korean regulations specify general limits, which vary with frequency, for extremely low power radio stations.
- The frequency bands designated for SRDs are not in accordance with the European regulations with the exception of WLAN, RFID and RTTT.
- Type approval and type registration according to the technical characteristics as specified by MIC is mandatory.

10.6 Differences in the ITU-R frequency allocation table with regard to SRDs in the three ITU regions

Short Range Device applications are not regarded as a radio service in terms of the ITU Radio Regulations. Hence, one would neither find a definition nor an entry in the ITU frequency allocation table with regard to SRDs. Consequently, SRD applications do not have a "status" in the sense of a primary or a secondary service and therefore they are not permitted to cause harmful interference to, nor claim protection from, other radio services.

In national regulations quite a number of terms are used for SRDs like "low-power transmitter", "low-power non-licensed radio equipment", "Part 15 transmitters", etc.

In 1995 CEPT decided to use the term "Short Range Devices" for these applications and since the development of ITU-R Recommendation SM.1538 this term is used in the ITU-R documentation as well.

With the advent of SRDs administrations assigned the so called "ISM frequency bands" to also be used by SRDs. The "ISM frequency bands" are mentioned in RR Nos 5.138 and 5.150.

5.138 reads:

The following bands:

6765 – 6795 kHz (centre frequency 6780 kHz)
433.05 – 434.79 MHz (centre frequency 433.92 MHz) in Region 1 except in the countries mentioned in No 5.280
61 – 61.5 GHz (centre frequency 61.25 GHz)
122 – 123 GHz (centre frequency 122.5 GHz) and
244 – 246 GHz (centre frequency 245 GHz)

are designated for industrial, scientific and medical (ISM) applications. The use of these frequency bands 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 ITU-R Recommendations.

5.150 reads:

The following bands:
13553 – 13567 kHz (centre frequency 13560 kHz)
26957 – 27283 kHz (centre frequency 27120 kHz)
40.66 – 40.70 MHz (centre frequency 40.68 MHz)
902 – 928 MHz in Region 2 (centre frequency 915 MHz)
2400 – 2500 MHz (centre frequency 2450 MHz)
5725 – 5875 MHz (centre frequency 5800 MHz) and
24 – 24.25 GHz (centre frequency 24.125 GHz)

are also designated for industrial, scientific and medical (ISM) applications. Radiocommunication services operating within these bands must accept harmful interference which may be caused by these applications. ISM equipment operating in these bands is subject to the provisions of No. 15.13.

ISM is defined in No 1.15 of RR as

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

Typical ISM applications include microwave ovens, diathermy equipment, RF welding, vulcanizing etc.

Subsequently, additional frequency bands were designated to SRDs, mainly in frequency bands allocated to the mobile service. However, these designations are different in the three ITU Regions as aforementioned.

One of the obstacles to the global harmonisation for SRDs is the designation of the ISM bands 433.05 – 434.79 MHz in Region 1 only and 902 – 928 MHz in Region 2 only. Innumerable applications are developed within these frequency bands. However, those devices cannot legally be used in the other Regions.

Annex 1─ Second Mandate from the European Commission

EUROPEAN COMMISSION
Information Society and Media Directorate-General

Electronic Communications Policy
Radio Spectrum Policy

Brussels, 10 March 2005
DG INFSO/B4

RSCOM05-07 Rev.

FINAL

RADIO SPECTRUM COMMITTEE

Working Document

Opinion of the RSC
pursuant to Article 3.2 of Radio Spectrum Decision 676/2002/EC

Subject: **Opinion of the RSC on a second Commission Mandate to CEPT to develop a strategy to improve the effectiveness and flexibility of spectrum availability for Short Range Devices (SRDs).**

This is a Committee working document which does not necessarily reflect the official position of the Commission. No inferences should be drawn from this document as to the precise form or content of future measures to be submitted by the Commission. The Commission accepts no responsibility or liability whatsoever with regard to any information or data referred to in this document.

Introduction

Following the positive opinion expressed by the RSC at its meeting held on 3 March 2004 (RSC#7), the Commission services issued a first Mandate to CEPT on SRD radio spectrum harmonisation (document RSCOM04-07). The objective of this Mandate was to identify and prioritise further harmonisation of frequency bands regarding relevant classes of Short Range Devices (SRDs) in the context of EU policy objectives. The Mandate aimed at strengthening the Internal Market for generally authorised radio communications products, notably by providing legal certainty to equipment defined as Class 1 under the R&TTE Directive, but also to consider means of improving access to spectrum for innovative SRD applications.

The final CEPT report in response to the Mandate[9] was transmitted to the Commission on 15 November 2004 and discussed at RSC#10 on 8 December 2004. The Member States and the Commission welcomed the report, with regards to the analysis of the current status of spectrum harmonisation for SRDs in Europe in the report, which provides a clear baseline to undertake actions aimed at strengthening the legal basis of the harmonisation process and the internal market for SRDs in the EU.

However, both RSC and CEPT recognised that further work was necessary to properly address the more forward-looking elements of the Mandate, namely identifying a long term strategy and a common approach to improve the effectiveness and flexibility of SRD spectrum availability. The Commission wishes to ensure that the objectives specified in the first SRD mandate are achieved in the EU, and is therefore proposing to issue a complementary second Mandate (draft attached) to “frame” the additional work on this issue which CEPT has now decided to undertake (new ECC FM PT43).

The RSC is hereby requested to give its opinion on the attached draft Mandate in accordance with the procedure laid down in Article 3.2 of the Radio Spectrum Decision 676/2002/EC.

[9] Letter from Mr. Chris van Diepenbeek (ECC) to Mr. Colasanti (European Commission) dated 15 November 2005. Ref. ECC/CvD.

Second Mandate to CEPT
to develop a strategy to improve the effectiveness and flexibility of spectrum availability for Short Range Devices (SRDs)

This mandate is issued to the CEPT without prejudice to the one-month right of scrutiny by the European Parliament, pursuant to Council Decision 1999/468/EC of 28 June 1999 (OJ L 184, 17.7.1999, p.23) on comitology procedure. This one-month period starts on 16 March 2005.

Purpose

To mandate CEPT to develop a common strategy and implementation approach to improve the effectiveness and flexibility of spectrum availability for Short Range Devices (SRDs) in the European Union.

Justification

Pursuant to Article 4 of the Radio Spectrum Decision[1], the Commission may issue mandates to the CEPT for the development of technical implementing measures with a view to ensuring harmonised conditions for the availability and efficient use of radio spectrum. Such mandates shall set the task to be performed and the timetable therefor.
As already referred to in the original Mandate to CEPT[2], SRDs are key enablers for a range of applications supporting the implementation of important EU policies, including policies such as those affecting innovation, competitiveness and the functioning of the Internal Market.
The work carried on by CEPT (SRD Maintenance Group) to date, as presented in the report of the original Mandate, has enabled a convergence between national approaches relating to spectrum for SRDs to take place. However, in view of the increasing proliferation of these devices, the regulatory situation requires considerations for long-term evolution in the European Union, in particular:

- To simplify regulatory procedures leading to the availability of spectrum for SRDs on an EU level.
- To further increase the transparency of procedures, and to accelerate the process for obtaining spectrum for SRDs;
- To lower barriers to entry regarding spectrum for SRDs and thereby supporting long-term pro-innovation policies.
- To take full advantage of economies of scale and competitiveness factors by avoiding unnecessary market fragmentation due to the divergence of national regulations.

• This second Mandate aims to address the effectiveness and flexibility of spectrum availability of SRDs in a generic sense. Aspects related to the consolidation of harmonisation efforts undertaken by CEPT in the past have initially already been addressed in the response to the original Mandate. In addition, "application-specific" or "technology-specific" issues are normally addressed via separate mandates on SRDs such as RLAN, SRR or UWB which have already been addressed to CEPT, and such mandates ought to be considered as reference on such issues.

[1] Decision 676/2002/EC of the European Parliament and of the Council of 7 March 2002 on a regulatory framework for radio spectrum policy in the European Community, OJ L 108 of 24.4.2002, p.1.
[2] Reference: RSCOM04-07 EN Final (Revised) dated 3 March 2004.

Main EU policy objectives

The EU policy objectives underlying this second Mandate remain those referred to in the first Mandate (see section 3 of the original Mandate on SRDs [3]).

SRDs can potentially contribute significantly to horizontal policy objectives (consolidation of the internal market; creating a competitive environment; contributing to the creation of an innovative friendly environment) and play an important role in the context of sectorial policies such as the implementation of an inclusive Information Society.

Specific objectives

With this proposed Mandate, the European Commission wishes to strengthen the internal market for SRDs by exploring methods and regulatory mechanisms to:

- promote more permissive conditions of use for short-range devices, (including inductive applications), harmonising European regulations on the least restrictive and justified limitations necessary to avoid harmful interference with other services, and exploring the possibility for systematically allowing operations below a common power threshold;
- anticipate the future evolution of EU demand for SRD spectrum and consider the most appropriate way to be able to provide the required resources in a timely fashion;
- increase the speed and effectiveness of procedures to grant access to SRD spectrum resources on a EU level;

Order and Schedule

CEPT is mandated to carry out the activities intended to support the objectives and policies presented above and in particular to:

- Consider whether the current definition and scope of regulations relating to "Short Range Devices" are appropriate in the long-term, in the light of expected developments of technology and of societal use of radio applications.
- Provide a critical analysis of the strengths and weaknesses of the current regulatory system regarding spectrum identification for SRDs and review the present effectiveness of the associated procedures in the context of the EU main policies and objectives as stated above, and of best practices applied outside the European Union for this area.
- Propose a new approach for improving the harmonisation achieved thus far, as well as the flexibility of spectrum usage for Short Range Devices (SRDs) at EU level in the light of the objectives described above.

The deliverable for this Mandate will be an overall (concise) policy guidance report and a final report subject to the following delivery dates:

- **1 December 2005**: Submission of an interim report including an overall policy guidance report identifying key strategic issues and proposing directions to address them.
- **1 June 2006[4]**: Submission of the final report to the Commission, including the proposed common approach.

[3] RSCOM04-07 EN Final (Revised) dated 3 March 2004.

In implementing this Mandate, the CEPT shall, where relevant, take the utmost account of Community law applicable, notably the R&TTE Directive 1999/5/EC, and to support the principles of technological neutrality, non-discrimination and proportionality.

The Commission, with the assistance of the Radio Spectrum Committee pursuant to the Radio Spectrum decision, may consider to apply the results of this Mandate in the European Community, and to issue further mandates to CEPT on this matter.

* * *

[4] This final deadline should be reassessed and confirmed at the occasion of the review of the interim report in December 2005.

Annex 2 ─ New Technologies

New and evolving technologies have a role to play in increasing the efficiency of spectrum use. The earlier generations of SRDs were designed to operate in lightly populated spectrum and application-specific allocations were the main method of ensuring interference-free operation. This principle is becoming harder to justify as the spectrum becomes more crowded and interference mitigation technologies become more widely available. A number of techniques are now emerging which should facilitate greater sharing of spectrum by SRDs including –

- Duty cycles: Applying duty cycles to the transmission time means both greater battery life for portable devices and more equitable access to the spectrum. Unfortunately, it is difficult to apply these techniques to devices like radio microphones or wireless audio and/or video links which tend to operate at a 100% duty cycle and which can not have natural transmission breaks to allow other devices to use the channel due to the nature of the application.
- Transmitter Power Control or Dynamic Power Control: Software driven protocols which, once the device has established its initial transmission path, reduce the power to the minimum necessary for maintaining the link thereby reducing the level of interference into other devices using the same channel.
- Listen Before Talk: LBT techniques, sometimes known as "polite technology", enable the product to check whether a channel within its permitted band is clear before transmitting. Due to variations in the noise floor, there may be difficulties in determining the signal threshold down to which the product should listen. However techniques exist which offer a possible solution to this problem – such as the use of a central base station for networked SRDs. Secondly, if a number of alternative channels are designated, an SRD can choose a channel that is unoccupied.
- Medium Access Protocols: This is a more intelligent form of LBT by which devices make use of a medium access protocol designed to facilitate spectrum sharing with other devices in the wireless network.
- Adaptive Frequency Agility: This technology allows systems, particularly hopping systems, to monitor its local radio environment and note, and avoid, channels that are regularly occupied.
- Wide Band Data Modulation techniques: Either Direct Sequence Spread Spectrum or OFDM (which spreads the signal over a wide bandwidth which is interpreted by narrow-band systems as an increase in the noise floor) or Frequency Hopping (which will present narrow-band systems with a frequency clash which is only sporadic and transitory and (hopefully) without introducing any fatal errors into either system).
- Wide Band Modulation techniques in combination with the use of a Medium Access Protocol and/or Adaptive Frequency Agility provide an even better means to share spectrum amongst different users of the band.
- Software Defined Radio: New techniques are emerging which will allow reconfigurable system architectures for SRDs, particularly when used in a network.
- Cognitive Radio: This has the capability to switch between or merge a number of the techniques listed above. This technology is designed to recognise its location, the systems operating around it and then transmits in accordance with a spectrum plan

pre-stored in its memory. This could enable greater spectrum efficiency by sharing in both location and time.

Some of these technologies are still at an early stage and the difficulty is in identifying those that have a future and designing a regulatory structure that is sufficiently flexible to encourage their further development while providing sufficient certainty to industry and protection to existing users. The use of these new technologies to solve spectrum shortages raises new regulatory issues such as those related to ensuring software integrity.

Annex 3 ─ The regulations for SRDs outside Europe

A3.1 FCC rules for legal low-power, non-licensed transmitters

Part 15 of the FCC "Code of Federal Regulation, Title 47" permits the operation of low power radio frequency devices (SRDs) without an individual license from the FCC or frequency co-ordination. The technical standards for Part 15 are designed to ensure that there is a low probability that these devices will cause harmful interference to other users of the spectrum. Intentional radiators, i.e., transmitters, are permitted to operate under a set of general emission limits or under provisions that allow higher emission levels than those for unintentional radiators, in certain frequency bands. Intentional radiators generally are not permitted to operate in certain sensitive or safety-related bands i.e. restricted bands, or in the bands allocated for television broadcasting.

Although an operator does not have to obtain a licence to use a Part 15 transmitter, the transmitter itself is required to have an FCC authorisation before it can be legally imported into or marketed in the United States of America. This authorisation requirement helps to ensure that Part 15 transmitters comply with the FCC's technical standards and, thus, are capable of operation with little potential for causing interference to authorised radiocommunications.

The measurement procedures for determining compliance with the technical requirements for Part 15 devices are provided or referenced within the rules.

A3.1.1 General Limits

§ 15.209 of Part 15 defines the general radiated emission limits for any intentional transmitter as follows:

Frequency (MHz)	Field Strength (microvolts/meter)	Measurement Distance (meters)
0.009 – 0.490	2400/F(kHz)	300
0.490 – 1.705	24000/F(kHz)	30
1.705 – 30.0	30	30
30 – 88	100	3
88 – 216	150	3
216 – 960	200	3
Above 960	500	3

These limits correspond to

- 11 dBµA/m @ 10m at 490 kHz to 1 dBµA/m @ 10m at 1700 kHz
- -57 dBm above 30 MHz
- -54 dBm above 88 MHz
- -51 dBm above 216 MHz
- -43 dBm above 960 MHz

and are at or near to the current spurious emission levels for SRD transmitters as defined by the ECC.

There are a number of exceptions or exclusions to the general limits in certain frequency bands for either special applications or types of use (e.g. intermittent control signals or periodic transmissions), with different emission levels ranging from some nanowatts to 4 watts e.i.r.p.

Although the general limits are already very low there are restricted frequency bands in which intentional radiators are not permitted to operate at all (with a few exceptions) because of potential interference to sensitive radiocommunications such as aircraft navigation, radio astronomy and search and rescue operations.

These restricted frequency bands are:

(MHz)	(MHz)	(MHz)	(GHz)
0.090 - 0.110	16.42 - 16.423	399.9 - 410	4.5 - 5.15
0.495 - 0.505	16.69475 - 16.69525	608 - 614	5.35 - 5.46
2.1735 - 2.1905	16.80425 - 16.80475	960 - 1240	7.25 - 7.75
4.125 - 4.128	25.5 - 25.67	1300 - 1427	8.025 - 8.5
4.17725 - 4.17775	37.5 - 38.25	1435 - 1626.5	9.0 - 9.2
4.20725 - 4.20775	73 - 74.6	1645.5 - 1646.5	9.3 - 9.5
6.215 - 6.218	74.8 - 75.2	1660 - 1710	10.6 - 12.7
6.26775 - 6.26825	108 - 121.94	1718.8 - 1722.2	13.25 – 13.4
6.31175 - 6.31225	123 - 138	2200 - 2300	14.47 - 14.5
8.291 - 8.294	149.9 - 150.05	2310 - 2390	15.35 - 16.2
8.362 - 8.366	156.52475 - 156.52525	2483.5 - 2500	17.7 - 21.4
8.37625 - 8.38675	156.7 - 156.9	2655 - 2900	22.01 - 23.12
8.41425 - 8.41475	162.0125 - 167.17	3260 - 3267	23.6 - 24.0
12.29 - 12.293	167.72 - 173.2	3332 - 3339	31.2 - 31.8
12.51975 -12.52025	240 - 285	3345.8 - 3358	36.43 - 36.5
12.57675 -12.57725	322 - 335.4	3600 - 4400	Above 38.6 GHz
13.36 - 13.41			

An example of a very restricted operation is that of biomedical telemetry devices in the frequency band 608 – 614 MHz which is allocated to the radio astronomy service.

It should be noted that although “general” limits are specified the regulation results in a “comb spectrum” due to the restricted bands.

Further, it should also be noted that due to the very low power levels given only a few applications may use the spectrum based on the general limits.

A3.1.2 Comparison between FCC Part 15 and ERC Recommendation 70-03

The approach to market access and access to spectrum for SRDs differs in USA and Europe. The following highlights of the advantages and disadvantages of both are provided in order to clarify some of the details in the regulatory process.

A3.1.2.1 Market access

In **Europe** in order to place equipment on the market the manufacturer or their representative has to ensure that equipment complies with all of the relevant EU Directives. The aim is to allow manufacturers to get equipment onto the market quickly. However, the responsibility falls on to the manufacturer.
In the **USA** an Authorisation is required from the FCC before equipment can be legally imported or marketed. This Authorisation requirement helps to ensure that Part 15 transmitters comply with the FCC's technical standards. This is similar to the type approval scheme which the R&TTE Directive replaced in Europe.

A3.1.2.2 Access to spectrum

In **Europe** a frequency allocation/designation/assignment is needed before a device can be used. Where there is a new application which requires a new frequency band the ECC will identify a possible designation. Compatibility studies will then be carried out to determine whether the application can co-exist with existing services in the band. Once all the studies have been completed and the technical parameters have been established then the application may be used, subject to any national restriction which may apply. Depending on the application this process can take from a few months to a few years.

In **USA** the FCC Part 15 specifies a general limit which varies with frequency. However, this limit requires operation at very low power levels. In addition to the general limits there are numerous bands across the radio spectrum open to SRD applications with different power levels.

In **Europe** there is currently no generic limit applicable. However, it is noted that a number of frequency bands have been designated for non-specific SRDs, for inductive devices and for other specific applications.

A3.1.2.3 Interference

In **Europe** most SRDs operate on frequency bands which have to be shared with other radio services. Extensive sharing studies are carried out prior to any designation of frequency bands to be used by SRDs. This reduces the potential of interference between applications and services.

In the **USA** SRDs operate on a variety of frequencies. They must share these frequencies with licensed primary and secondary services, which are protected from Part 15 SRDs. The FCC has issued rules to limit the potential for harmful interference to licensed transmitters by SRDs. In its rules, the FCC takes into account that different types of products that incorporate SRDs have different potentials for causing harmful interference. As a result, the FCC's Rules are most restrictive on products that are most likely to cause harmful interference, and less restrictive on those that is least likely to cause interference.

A3.2 Technical and operational parameters and spectrum requirements for SRDs in China

In China SRDs need not be individually licensed, however the device has to pass examinations or tests as required by the Ministry of Information Industry of China, to ensure that the SRD perform within the limits given.

According to the rules issued by the Ministry of Information Industry of China the relevant formalities have to be adhered in order to develop, produce or import SRDs. SRDs, without type approval performed by the Ministry of Information Industry of China, cannot be produced, sold and used in China. Besides these general provisions additional specific regulations apply for a number of SRD applications such as, inter alia, audio transmitters, biomedical telemetry, remote control devices, data transmission equipment, alarm transmitters and model control applications.

SRDs are classified into twelve categories with maximum radiated power between 750 μW and 1 Watt and use frequency bands which are not in accordance with the European regulations, except for some bands mentioned in ITU Radio Regulations Nos 5.138 and 5.150 respectively.

The Chinese regulation does not include provisions for general field strength or power limits. However, one of the twelve SRD categories is called “General SRDs”. General SRDs may use the frequency bands 1.7 – 2.1 MHz; 2.2 – 3.0 MHz; 3.1 – 4.1 MHz; 4.2 – 5.6 MHz; 5.7 – 6.2 MHz; 7.3 – 8.3 MHz; 8.4 – 9.9 MHz. The maximum field strength for all of these frequency bands is set to 50 μV/m @3m and the bandwidth is limited to 200 kHz.

Further, general SRDs may use the “ISM – Bands” i.e. 6.765 – 6.795 MHz; 13.553 – 13.567 MHz; 26.957 – 27.283 MHz; 40.66 – 40.70 MHz and 24 – 24.250 GHz with different maximum field strength levels between 1000 μV/m@3m and 250 000 μV/m@3m.

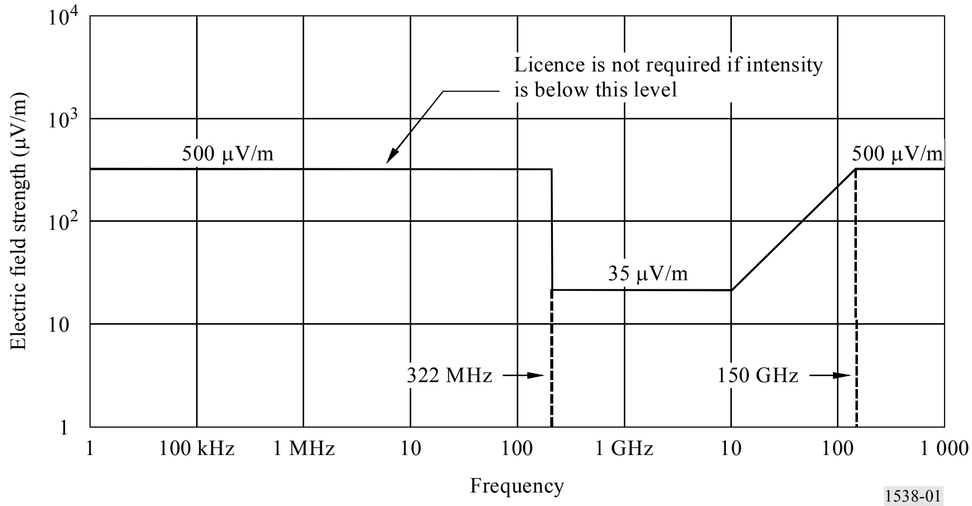
For the remaining SRD categories frequencies are designated below 1 GHz, predominantly in the 200 MHz and 400 MHz bands with power levels ranging from 3 mW to 1 W.

A3.3 Japanese requirements for low-power, non-licensed radio equipment

- In Japan, the establishment of a radio station in principle requires a licence from the Ministry of Internal Affairs and Communications (MIC). However, radio stations emitting extremely low power and low-power radio stations can be established without obtaining an individual licence, provided that all of the equipment has been granted a certification of conformity with the required technical standards.

- An extremely low power station is radio equipment whose emissions meets the tolerable value of electrical field strength measured in 3 m distance as follows:

Tolerable value of electric field strength 3 m distant from a radio station emitting extremely low power



This mask corresponds to the following figures:

Frequency band	Electric field strength (µV/m)
$f \leq$ 322 MHz	500
322 MHz < $f \leq$ 10 GHz	35
10 GHz < $f \leq$ 150 GHz	3.5 × f (1), (2)
150 GHz < f	500

(1) f (GHz).

(2) If 3.5 x f > 500 µV/m, the tolerable value is 500 µV/m.

Low-power radio stations are regarded as radio stations using only radio equipment emitting 10 mW or less (e.r.p. or e.i.r.p.), intended for specific SRD applications, limited to the use of designated frequencies for each category and certified for technical standards compliance with the technical characteristics as specified by MIC.

The SRD applications in question are:

- Telemeter, telecontrol and data transmission
- Wireless telephone
- Radio pager
- Radio microphone
- Medical telemeter
- Hearing aid
- Mobile land stations for personal handy phone (PHS)
- Radio stations for low-power data communication systems/wireless LAN

– Wireless card
– Millimetre-wave radar
– Radio stations for cordless phones
– Mobile station identification
– Radio stations for low-power security systems
– Radio stations for digital cordless phones
– Mobile land stations for toll-road automatic toll collection systems.

For each frequency band designated the type of emission, channel spacing, occupied bandwidth, antenna power, antenna gain and carrier sense are stipulated.

Apart from the frequency bands for wireless telephones, which are in Europe not included in the scope of SRDs, the frequency bands used in Japan for SRDs are predominantly in the 400 MHz and 1200 MHz bands. Additionally the band 13.56 MHz is designated for RFID applications, the 2.4 GHz and the lower 5 GHz bands for wireless LANs and the 76.5 GHz for RTTT radar applications.

A3.4 Technical parameters and spectrum requirements for low-power radio stations in Korea

Radio stations which may be operated without individual licence are listed in Article 30 of the Presidential Decree of Radio Act and are classified into nine categories as follows:

1) Type registered extremely low-power devices (LPD Class 1)
2) Type registered low-power devices (LPD Class 2)
3) Type registered cordless phone
4) Type registered citizen-band transceiver
5) Type registered specified low-power devices
6) Measurement instruments
7) Only Receiver
8) Type registered radio equipment for relaying communication service to the blanket area such as indoor, underground or tunnel.
9) Type registered radio equipment intended to be operated within limited area.

For this study only the regulations for categories 1), 2) and 5) are of interest.

Extremely low-power devices (LPD Class 1)

The electric field strength of radio equipment in this class shall comply with the limits indicated in the table when it is measured at the distance of 3m from the equipment.

The limit of electric field strength of the LPD Class 1

Frequency band	Electric field strength (μV/m)
$F \leq 322$ MHz	500$^{(1)}$
322 MHz < $f \leq 10$ GHz	35
$F \geq 10$ GHz	3.5 x $f^{(1)}$, but not greater than 500

(*1) Frequency in GHz

Note: The near field measurement compensation factor 20 log (wavelength/18.85) should be applied for frequencies < 15 MHz.

Low-power devices (LPD Class 2)

The electric field strength of the low-power devices in this class shall be less than 200 μV/m measured at a distance of 500m (which corresponds to 10mV/m or less when it is measured at the distance of 10m). The spectrum requirements and the technical criteria are defined.

Applications in this category are

- radio controller for model car or model boat in 27 MHz, 40 MHz and 75 MHz
- radio controller for model aircraft in 40 MHz and 72 MHz
- radio controller for toy, security alarm and telecommand in the 13,56 MHz,
- 27 MHz and 40 MHz ISM bands
- RFID systems in the 13,56 MHz band

Specified low-power devices (LPD Class 5)

The specified low-power radio stations are classified into 12 applications as follows:

1) Data transmission in the 173 MHz band, 219 MHz band with duplex operation in the 224 MHz band, 311 MHz band, 424 MHz band and 447 MHz band.

2) Radio paging on four frequencies in the 219 MHz band.

3) Vehicle identification system (type of RFID) in the 2.44 GHz band.

4) Data communication in the 2.4 GHz, 5.8 GHz, 17 GHz and 19 GHz bands.

5) Wireless microphones in the 73 MHz, 74.5 MHz, 75.7 MHz, 173.1 MHz, 220 MHz, 224 MHz, 750 MHz, 929 MHz and 951 MHz bands.

6) Safety systems in the 447 MHz band.

7) Video transmission on 4 frequencies in the 2.4 GHz band.

8) Inducement of visually impaired person on 4 frequencies in the 235 MHz band for the fixed part and 4 frequencies in the 358 MHz band for the mobile part of the system.

i. Dedicated short-range communications (intelligent transport system) in the frequency bands 5795 – 5805 MHz and 5810 -5815 MHz.

ii. Equipment for RFID / ubiquitous sensor network in the 13.56 MHz, 433.670 – 434.170 MHz and 908.5 – 914.0 MHz bands.

iii. Wireless access systems including RLAN in 5150 – 5250 MHz; 5250 – 5350 MHz and 5470 – 5650 MHz bands.

iv. Equipment installed indoors, underground or in a tunnel for relaying public radiocommunication service in the frequency bands assigned to the corresponding service station.

The spectrum requirements and the technical criteria for these specified low-power radio stations are established in the MIC regulations which define the power levels for these SRDs between 3mW and 10mW except those for WLAN and Vehicle identification systems.

As a basic principle the Radio Wave Act of Korea stipulates that "Any person who intends to manufacture or import apparatus for wireless facilities and equipment shall undergo a type approval test conducted by the Minister of Information and Communication and file a type registration with the Minister of Information and Communication".

Annex 4 ─ Review of ERC Recommendation 70-03 Annexes

Some of the Annexes of ERC/REC 70-03 are application-specific while others are generic in nature. The nature of each of the Annexes of the current ERC/REC 70-03 is described below:

- Annex 1 on Non-Specific SRDs: This is a fully generic annex, covering the majority of SRD applications. These devices have to fulfil a minimum set of technical requirements to use the specified spectrum.
- Annex 2 on Devices for Detecting Avalanche Victims: This is an application-specific Annex which has inherent human safety implications. Devices covered under this Annex are "tolerated" on specific frequencies allocated to other services. These frequencies were intentionally chosen because of their propagation characteristics and ability to detect a human body buried under an avalanche. The CEPT is currently considering the scope of this Annex with a view to introducing new applications under it.
- Annex 3 on Wideband Data Transmission (WDT): This is an application-specific Annex for equipment which is used in wireless local area networks. Such networks provide high speed data communications and may be operated with or without attachment to a wired communications infrastructure. An essential characteristic of this equipment is the use of a medium access protocol designed to facilitate spectrum sharing with other devices in the wireless network.

  In 2002, the CEPT agreed to a name change to bring other RLAN applications within the scope of this Annex. All of these wireless networking applications use an intelligent access protocol to access the network.

  The 2.4 GHz part (band a) replaces the previous CEPT Recommendation T/R 10.01. The ERC Decision referenced in Annex 3 for band (a) is ERC Decision (01)07.

  Examples of 2.4 GHz wireless networking applications covered by this Annex are Wi-Fi, Bluetooth™, HomeRF™ and Zigbee™.

  The 5 GHz part (bands b, c and d) of this Annex 3 refers to ECC Decision(04)08.
- Annex 4 on Railway applications is an application-specific Annex. The reason for this is that the particular application requires European harmonisation and higher power than is allowed by the generic Annexes of ERC/REC 70-03.

- Annex 5 on Road Transport and Traffic Telematics: This is an Annex which covers a fairly wide range of applications associated with road transport. It should be noted that the policy decisions associated with this Regulation are in the hands of a number of other European Institutions. These include CEN, Automotive Industry associations and other EU Commission branches than those usually involved in radio matters.

- Annex 6 on Equipment for Detecting Movement and Alert: This is not an application-specific Annex. It covers a fairly wide range of applications associated with detecting movement and alert, ranging from automatic slide-door, sophisticated microwave perimetric protection systems for sensitive sites (e.g. oil refineries, military bases etc.)

to car speed detectors used by the police forces. The main reason for a separate Annex to Annex 1 was to allow higher power limits than “generic” SRDs and to indicate the specific frequencies that these devices can use.

- Annex 7 on Alarms: This Annex covers a fairly wide range of alarm applications which have inherent human safety issues or related security issues. Examples of alarm applications include wireless fire alarm systems and social alarms for disabled or elderly people. CEPT Administrations, industry associations, ETSI, CENELEC and the European Commission agreed on the necessity for some frequencies specifically designated for these applications to ensure some level of reasonable protection for alarms.

- Annex 8 on Model Control: This is an application-specific Annex which was developed to reflect the de-facto consolidated harmonisation (even outside Europe) of some frequencies channels within the 27 MHz, 35 MHz and 40 MHz bands that are also used for other radio Services, to allow higher power than is allowed by the “generic” SRDs (e.g. 40 MHz) and to ensure the seamless international operation of devices originating from many countries and operating simultaneously.

- Annex 9 on Inductive Applications: This is a fully generic Annex which allows all technologies under certain power limit restrictions in order to grant protection to other radio services (in many cases ITU-R Primary Services). Annex 9 covers a wide range of SRD market applications, including inductive RFIDs. A large number of frequency ranges are listed in Annex 9 due to the worldwide roaming of inductive SRDs, specific coexistence rules (compatibility sharing) with existing ITU-R Primary Services and the wide operational bandwidth and propagation characteristics of the low frequencies required by inductive systems. While preparing this Report, the CEPT ECC is in the final stages of introducing a generic limit for ultra low power (-5 dBuA/m at 10 m) inductive applications operating in the 148.5 kHz – 30 MHz frequency range.

- Annex 10 on Radio Microphones: This Annex covers a fairly wide range of radio microphone applications. Some frequency bands are specific, for example, bands for professional use (e.g. hundreds of simultaneous channels operating during live theatre or broadcast events). Such operation is often in frequency bands designated to other Primary Services e.g. Broadcasting. The Radio Microphones and Wireless Audio (see ERC/REC 70-03 Annex 13) communities agreed to allow more generic use of the 863 - 865 MHz band. CEPT ECC recently published new rules accordingly (see parameters outlined in ERC/REC 70-03 Annex 1). Aids for the hearing impaired are also covered under this Annex.

- Annex 11 on Radio Frequency IDentification: This Annex covers a fairly wide range of RFID applications. It includes the 865-868 MHz which is targeted mainly at logistic applications and 2.4 GHz which relates to general industrial use. The Annex is necessary because these applications require higher power levels than those required by general purpose SRDs.

- Annex 12 on Wireless Applications in Healthcare: This is an application-specific Annex because of the inherent human health and safety implications associated with these devices. These devices are allowed to operate on specific frequencies allocated to other radio services under the condition of using certain interference mitigation techniques e.g. frequency agility.

- Annex 13 on Wireless Audio Applications: This Annex covers a fairly wide range of wireless audio applications e.g. cordless loudspeakers, headphones, baby monitors and door entry systems. The main frequency band (863-865 MHz) listed in this Annex is also used for Radio Microphones (Annex 10) and for generic SRDs (Annex 1). This separate Annex is a practical way to identify the associated rules under which a duty cycle of up to 100% is permitted for some applications but not for others.

Annex 5 ─ Notes specifically related to a possible method for access to Broadcast bands

Terrestrial broadcast services are allocated in specific bands on primary basis mainly within the frequency range 148.5 kHz to 862 MHz and beyond. Per definition these services are protected shall not interfered by other services. It shall be noted that broadcast transmitters:

a) are located at specific locations to cover certain areas. Within a coverage area a minimum field strength level is guaranteed. Outside the coverage area there is no guarantee of the service.
b) use a certain minimum protection distance before the same frequency can be reused in order to minimize interference between the coverage areas for different transmitters.
c) use a certain minimum protection distance before an adjacent channel frequency can be reused in order to minimize interference between different transmitter coverage areas.
d) may not use a specific allocated spectrum at all time of the day (24 hours).

Based on the above it may be possible for other equipment to share with broadcast at all time if the following conditions as meet:

a) the frequency is not used by the broadcast service at certain time; or
b) the broadcast field strength is well below the guaranteed service level at a specific local position; and
c) the other equipment radiated spectrum mask is limited inside the broadcast channel.

Other equipment than broadcast can operate to meet the above criteria when using Listen Before Talk (LBT) and Adaptive Frequency Agility (AFA) if these features are set properly. This will be used as a method to access the broadcast spectrum. This will ensure that the equipment will operate within a certain total broadcast band and even if some broadcast frequencies are occupied at the specific location.

To protect broadcast service it is necessary to set the LBT threshold level for equipment such that an inappropriate transmission is avoided at all times. The required LBT threshold shall meet the necessary sharing criteria, which has to be included in both ETSI standards and ECC recommendations.

A sharing method between other services than broadcast in a designated broadcast band but momentarily vacant spectrum needs to use the normal sharing criteria. Consequently, it is necessary to use the normal Frequency Management and Spectrum Engineering tools in order to determine which radio equipment will be able to access the vacant broadcast spectrum.

Annex 6 ─ Glossary

This section is intended to provide a glossary of some of the technical terms referred to in this Report.

Definition of terms

A Common question relates to definitions of units used to express permitted levels of signal transmission. Though all used are appropriate in some instances, an explanation of the particular term (i.e. erp, eirp, etc) would be helpful.

equivalent isotropically radiated power (e.i.r.p.): The product of the power supplied to the antenna and the antenna gain in a given direction relative to an isotropic antenna

effective radiated power (e.r.p.) (in a given direction)*:* The product of the power supplied to the antenna and its *gain relative to a half-wave dipole* in a given direction.

A consideration of "Duty Cycle"

For the purposes of ERC Rec 70-03, duty cycle is defined as the ratio, expressed as a percentage, of the maximum transmitter "on" time on one carrier frequency, relative to a one hour period unless otherwise mentioned in the relevant Annex.

With the recent introduction of LBT/AFA techniques the question of the continued validity of the duty cycle concept was posed. For all product categories the response was in favour of its retention. Reasons given were its simplicity when applied to simple low cost, single channel products, particularly when combined with minimum "off" times between transmission bursts, sometimes as an important parameter to protect other packet services. Another, social reason, was consideration of duty cycle as a tool to assist in reducing human exposure to radiation (see EU Council Recommendation 1999/05/EC) even though the usual very low power, implicit to SRDs, minimises that risk.

Relationship between µV/m and W

Watts (W) are the units used to describe the amount of power generated by a transmitter. Microvolts per metre, µV/m, are the units used to describe the strength of an electric field created by the operation of a transmitter.

A particular transmitter that generates a constant level of power, W, can produce electric fields of different strengths, µV/m, depending on, among other things, the type of transmission line and antenna connected to it.

Although the precise relationship between power and field strength can depend on a number of additional factors, a commonly-used equation to approximate their relationship is:

$$PG / 4\pi D^2 = E^2 / 120\pi$$

where:

P : transmitter power (W)

G : numerical gain of the transmitting antenna relative to an isotropic source

D : distance of the measuring point from the electrical centre of the antenna (m)

E : field strength (V/m)

$4 \pi D^2$: surface area of the sphere centred at the radiating source whose surface is D m from the radiating source

120π : characteristic impedance of free space (Ω).

Using this equation, and assuming a unity gain antenna, $G = 1$ and a measurement distance of 3 m, $D = 3$, a formula for determining power (given field strength) can be developed:

$$P = 0.3 E^2$$

where:

P : transmitter power (e.i.r.p.) (W)

E : field strength (V/m).

Annex 7 ─ List of abbreviations and definitions for the purposes of this Report

AFA	Adaptive Frequency Agility
CEPT	European Conference of Postal and Telecommunications Administrations
ECC	Electronic Communications Committee
EFIS	ERO Frequency Identification System.
EICTA	European Information & Communications Technology industry Association.
ERM	Electromagnetic Compatibility and Radio Spectrum Matters
ERO	European Radiocommunications Office.
ETSI	European Telecommunications Standard Institute
EU	European Union
FCC	Federal Communications Commission – US regulator.
FHSS	Frequency Hopping Spread Spectrum
GDP	Gross Domestic Product – a measure of economic activity.
GRSC	Global Radio Standard Collaboration
IEEE	Institute of Electrical and Electronics Engineers – a developer of global industry standards in a broad-range of industries
ISAD	Interessenverband Short Range Device Anwender Deutschland. (German Association of SRD Manufacturer and User (Applicants)
ISM	Industrial, Scientific and Medical applications – see ITU RR Nos. 1.15, 5.138 and 5.150
ITU-R	Radiocommunication sector of the International Telecomuunication Union
LBT	Listen Before Talk.
LPD	Low Power Device ; term used instead of SRD
LPRA	Low Power Radio Association.
MIC	Ministry of Information and Communication of Korea, Korean regulator
MIC	Ministry of Information and Communication of Japan; Japan's regulator
PMR	Professional Mobile Radio / Private Mobile Radio
R&TTE	Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity
Region	Region (with capital "R") is related to the three Regions as defined in the RR Article 5 for the purposes of frequency allocation
RFID	Radio Frequency Identification
RR	Radio Regulations which complement the Constitution and the Convention of the International Telecommunication Union
RTTT	Road Transport & Traffic Telematics
SDR	Software Defined Radio
SM.	Series of ITU-R Recommendations related to spectrum management

SME	Small to Medium sized Enterprises.
SRD	Short Range Device
SRD MG	FM's Short Range Device Maintenance Group. Responsible for maintaining CEPT Recommendation 70-03 on SRDs.
TCAM	Telecommunications and Conformity Assessment and Market surveillance committee
WGFM	CEPT Working Group Frequency Management
WLAN	Wireless Local Area Networks