



Addendum to CEPT Report **59**

Addendum to the CEPT Report 59 in response to the EC Permanent Mandate on the "Annual update of the technical annex of the Commission Decision on the technical harmonisation of radio spectrum for use by short range devices"

Possibilities for a harmonisation approach for the bands 870-876 MHz and 915-921 MHz also taking into account new opportunities in the band 862-868 MHz

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0 EXECUTIVE SUMMARY

This Report complements CEPT Report 59 [1] on the "Annual update of the technical annex of the Commission Decision on the technical harmonisation of radio spectrum for use by short range devices" in response to the permanent Mandate on SRD, which has been approved for publication in June 2016.

As such, this Report describes the proposed additional changes on the technical harmonisation of radio spectrum for use by Short Range Devices (SRD) [2] [3].

Proposals

The proposals set out in ANNEX 3: gather the following changes:

- new opportunities for wideband data transmission devices in data networks¹ in the bands 863-868 MHz and 915.8-920.8 MHz; in the band 915.8-920.8 MHz the frequency range 918-920.8 MHz is preferred; Member States may alternatively implement at least 2.8 MHz within the whole frequency range 915.8-920.8 MHz depending on national circumstances, e.g. by considering the future railway mobile communication system;
- new opportunities for RFID interrogator channels in the band 915-921 MHz (four 400 kHz channels);
- new opportunities for SRD in data networks in the band 870-875.6 MHz as well as within the four interrogator RFID channels in the bands 865-868 MHz and the upper three RFID interrogator channels in 915-921 MHz (two 200 kHz channels for SRD in data networks in each of the three available RFID interrogator channels in 915-921 MHz); in the band 870-875.6 MHz the frequency range 874-875.6 MHz is preferred; Member States may alternatively implement at least 1.6 MHz within the whole frequency range 870.0-875.6 MHz depending on national circumstances, e.g. by considering the future railway mobile communication system;
- new opportunity for 25 mW non-specific SRD in data networks in the band 915.8-920.8 MHz; the frequency range 918-920.8 MHz is preferred; Member States may alternatively implement at least 2.8 MHz within the whole frequency range 915.8-920.8 MHz depending on national circumstances, e.g. by considering the future railway mobile communication system.

They are presented in the table format of the technical annex of the EC Decision for SRD, with an additional column with considerations to make it easier to understand. These proposals complement the harmonised frequency bands in the range 863-870 MHz already defined in the EC Decision [3].

SRD in data networks and wideband data transmission systems in data networks within the proposed bands in 863-868 MHz and 915-921 MHz should comply with Mask Option 1 (-54 dBm/100kHz in the spurious domain, see Annex 1 of ECC Report 246 [11] and ECC Report 261 [10] respectively).

This new SRD regulatory framework within 915-921 MHz brings the clear benefit to achieve a not only European harmonisation but also a wider harmonisation with many countries outside of Europe. The 902-928 MHz band was originally for ITU-R Region 2; however, it does get widely copied around the world, in particular in Australia and New Zealand. It is also becoming widespread across Asia, in particular for RFID, such as in Singapore, Vietnam, Malaysia and Japan. There are also aspects of it in South Africa, and other countries, mixing European and American regulations.

As by September 2016, a number of CEPT administrations have either in full or partially implemented SRD and/or RFID regulations in the concerned frequency bands 870-876 MHz and 915-921 MHz, see information in Annex 1.

The demand for automotive applications and audio applications in the bands 870-876 MHz and 915-921 MHz has not been confirmed.

¹ A network access point in a data network is a fixed terrestrial short range device that acts as a connection point for the other short range devices in the data network to service platforms located outside of that data network. The term data network refers to several short range devices, including the network access point, as network components and to the wireless connections between them.

Need for flexibility

With regard to the incumbent services and radio applications it has to be taken into account that the frequency bands 870-876 MHz and 915-921 MHz are allocated to the mobile service (except aeronautical mobile service) on ITU level (Region 1) and on CEPT level (see latest version of ECA Table, May 2016).

Article 3 of Commission Implementing Decision (2006/771/EC [2], latest amended by 2013/752/EU [3]) on harmonisation of the radio spectrum for use by short-range devices requires that *“Member States shall designate and make available, on a non-exclusive, non-interference and non-protected basis, the frequency bands for the categories of short-range devices, ...”*. Article 2 of this Decision defines that *“‘non-interference and non-protected basis’ means that no harmful interference may be caused to any radio communications service and that no claim may be made for protection of these devices against harmful interference originating from radio communications services.”*

In addition, it is highlighted in recital-3 of EC Decision 2006/771/EC that *“... radiocommunications services, as defined in the International Telecommunications Union Radio Regulations, have priority over short-range devices and are not required to ensure protection of particular types of short-range devices against interference.”*

The EC Decision for SRD explains in (3) that *“as this type of device uses radio spectrum with low emission power and short-range emission capability, its potential to cause interference to other spectrum users is typically limited. Therefore such devices can share frequency bands with other services which are, or are not, subject to authorisation, without causing harmful interference, and can co-exist with other short-range devices. Their use should therefore not be subject to individual authorisation pursuant to the Authorisation Directive 2002/20/EC.”*

The word ‘should’ as shown above normally carries the meaning of a recommendation but not the meaning of a mandatory aspect. In addition, the authorisation aspect is a matter on national level of the Member States.

This means that CEPT administrations have to protect existing radiocommunications service use (i.e. mainly national military and governmental use, national ER-GSM use) in the considered bands and the options for implementation in this Report must take this into account. According to Article 1 (4) Decision No 676/2002/EC [4] of the European Parliament and of the Council of 7 March 2002 on a regulatory framework for radio spectrum policy in the European Community (Radio Spectrum Decision), harmonisation measures based on the Radio Spectrum Decision has to be *‘without prejudice to measures taken at Community or national level, in compliance with Community law, to pursue general interest objectives, in particular relating to content regulation and audio-visual policy, to the provisions of Directive 1999/5/EC and to the right of Member States to organise and use their radio spectrum for public order and public security purposes and defence’*.

This includes avoiding harm on respective usages at national level.

Any future EU harmonisation measure has to ensure that neither an implementation on national level has to be mandatory what could affect that national sovereignty, nor must such a harmonisation measure lead to a situation that the free circulation and use of equipment in Europe might cause negative effects on the existing usages in the relevant countries.

The general approach for these new opportunities in the bands 870-876 MHz and 915-921 MHz is to give administrations some flexibility with regard to the precise implementations. This is necessary in order to ensure protection of the radio services:

- In countries where parts or all of these frequency ranges are used by military applications and coordination is not possible, Member States may decide not to implement the relevant entry partially or in its entirety in accordance with Article 1(4) of Decision 676/2002/EC [4];
- The requirement of the protection of ER-GSM implies that the respective entry cannot be made available without additional restrictions, e.g. geographical restriction, reduced duty cycle, etc.;
- National rules may be needed to ensure local coordination in order to avoid interference to radio services operating in the band as well as in the adjacent bands, e.g. due to intermodulation or blocking;

- For entries for wideband data transmission devices and data networks within the bands 870-876 MHz and 915-921 MHz, some preferred frequency ranges are indicated but it is also proposed to indicate wider frequency ranges within which alternative implementation may be possible, depending on national circumstances.

A general authorisation regime is the preferred solution for the harmonisation in 870-876 MHz and 915-921 MHz. However, the harmonisation approach should also include the freedom for national administrations to either include registration/notification duties as part of a general authorisation or to implement a registration/notification or an individual authorisation regime for SRD in data networks and RFID installations where needed in order to ensure that the risk of harmful interference is negligible. It should be made clear to applicants that registration/notification or individual authorisation do not provide them with protection. Exclusive access to spectrum by licensed applications is to be avoided, i.e. shared use should be possible up to a certain extent ('do not monopolise part of the spectrum to only one SRDs/M2M/IoT network').

In addition, the proposals made in ANNEX 3: are considered to be as technology-neutral as possible, enabling future innovation and flexibility with regard to how services can be offered.

As a consequence of the flexible approach, SRD and RFID equipment operating in frequency ranges 870-876 MHz or 915-921 MHz **cannot** fall under the radio equipment class 1 category according to the definitions in the Radio Equipment Directive: 'Class 1: radio equipment that can be operated without any restriction in EU, EEA and EFTA'.

The new entries are dominantly for new types of M2M/IoT applications in SRD networks, proposed to either fall into the wideband transmission system category, RFID or in the non-specific SRD category (latter one with the other usage restriction that the technical conditions apply only for data networks). These applications are typically bound to fixed locations as the typical common usage scenario. The proposal for using the non-specific category (instead of proposing a new category 'data networks' for the EC Decision) is made based on the perspective that such data acquisition networks can serve a very broad range of purposes, e.g. for utilities, tourist information, in the transportation sector, anything else in 'smart cities' etc., and the category should be open to future innovation.

Noting that there is free circulation of radio equipment within the EU internal market under the Radio Equipment Directive, it is only possible to make a harmonisation proposal for 25 mW non-specific SRDs in the range 915.8-920.8 MHz under the indicated conditions in ANNEX 3:. Individual administrations may be in position to adopt less restrictive conditions or wider frequency ranges as indicated in ERC/REC 70-03 [5] Annex 1 band h3) on a national basis.

Harmonisation proposals for non-specific SRD use were discussed, but were felt to contradict the obligations of the regulatory authorities to ensure protection of radio services (in this case mainly military use and ER-GSM).

The flexible implementation concept provides new opportunities for new innovative applications and attempts to activate the spectrum opportunities where possible, e.g. by using possibilities provided by geographical sharing.

The proposal in this report is not a complete approach but considers what seems possible at this time and for items for which a consensus could be achieved. Chapter 7 identifies items for further investigations.

For countries considering the future railway mobile communication system, this report makes a recommendation to avoid at this stage SRD/RFID implementations in the upper 2 x 900 kHz, i.e. in 875.1-876 MHz and 920.1-921 MHz, since this is an option to enable the future migration from GSM-R. However, it is noted that it will take time in the future until all aspects will be investigated within CEPT and elsewhere.

In addition, it should be noted that all new proposed entries in ANNEX 3: refer to the harmonised standards (or equivalent specifications), with standardisation activities on-going in ETSI. This shows the importance of the standardisation work in this regard, also to ensure that all requirements set out in the regulatory approach are accomplished, and this will also help to protect services in the bands 870-876 MHz and 915-921 MHz and adjacent bands.

It is proposed to include geographical restrictions in the possibilities for national implementation since it can provide a means for some administrations to fulfil the minimum amount of spectrum to be implemented over a considerable part of their territory. Geographical separation can also be a possibility to be investigated on national level with governmental services.

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LIST OF ABBREVIATIONS

Abbreviation	Explanation
3GPP	3 rd Generation Partnership Project
Adif	Rail Spanish
AFA	Adaptive Frequency Agility
ALD	Assistive Listening Device
APC	Adaptive Power Control
ARNS	Aeronautical Radionavigation Service
AS	Aeronautical Service
BEREC	Body of European Regulators for Electronic Communication
BR IFIC	Radiocommunication Bureau International Frequency Information Circular
BS	Base Station
CCS	Control-Command and Signalling
CEPT	European Conference of Postal and Telecommunications Administrations
DAA	Detect-And-Avoid
DB	Deutsche Bahn
DC	Duty cycle
ECA	European Common Allocation (Table)
ECC	Electronic Communications Committee
EFIS	ECO Frequency Information System
EIRENE	European Integrated Railway Radio Enhanced Network
ERA	European Railway Agency
ERC	European Radiocommunications Committee
ER-GSM	Extended R-GSM
e.r.p.	effective radiated power
ERTMS	European Rail Traffic Management System
ETCS2	Euro Truck Simulator 2
ETSI	European Telecommunications Standards Institute
EU	European Union
FCC	Federal Communications Commission
FH	Frequency Hopping
FRMCS	Future Railway Mobile Communication System
FTA	Finnish Transport Agency
GPRS	General Packet Radio Service
GSM	Global System for Mobile communications
IEEE	Institute of Electrical and Electronics Engineers
IoT	Internet of Things
ISM	Industrial, Scientific and Medical
ITS	Intelligent Transport Systems
ITU-R	International Telecommunication Union – Radiocommunication Sector
LBT	Listen-Before-Talk
LDC	Low Duty Cycle
LORA	Long Range

LPWAN	Low Power Wide Area Network
LTE	Long Term Evolution
LTN	Low Throughput Networks
M2M	Machine-to-machine
M3N	Metropolitan Mesh Machine Networks
MFCN	Mobile/Fixed Communications Networks
MRAN	Metropolitan/ Rural Area Networks
NAP	Network Access Point
NATO	North Atlantic Treaty Organisation
NBN	Narrowband Networked
NJFA	NATO Joint Civil/Military Frequency Agreement
NRA	National Regulatory Authority
NRP	Network Relay Point
NTFA	National Table of Frequency Allocation
OBB	Out-Of-Band
PAMR	Public Access Mobile Radio
PMR	Private Mobile Radio
QoS	Quality of Service
RFF	French national railway network
RFID	Radio Frequency Identification
RR	Radio Regulations
RSPP	Radio Spectrum Policy Programme
SBB	Schweizerische Bundesbahnen
SEAMCAT	Spectrum Engineering Advanced Monte Carlo analysis Tool
SM/SG	Smart Metering/ Smart Grid
SRD	Short Range Devices
TR	Technical Report
TSI	Technical Specification for Interoperability
TRR	Tactical Radio Relay
UAS	Unmanned Aircraft Systems
UAV	Unmanned Aircraft Vehicle
UE	User Equipment
UGV	Unmanned Ground Vehicle
UHF	Ultra High Frequency
UIC	Union Internationale des Chemins de Fer (International Union of Railways)
UMTS	Universal Mobile Telecommunications System
VHF	Very High Frequency
WG FM	Working Group Frequency Management
w/o	without
WRC	World Radiocommunications Conference

1 INTRODUCTION

General guidance principles for the task to create this Addendum to CEPT Report 59 [1] were given by the ECC WGFM at their 85th meeting in May 2016:

1. “Foster new SRD regulatory frameworks within 915-921 MHz for new applications with a clear benefit to achieve a global harmonisation;
2. Foster new SRD regulatory frameworks within 870-876 MHz for European harmonisation aiming to assist emerging new applications for SRD;
3. Streamline the demand: do not consider SRD automotive regulatory framework;
4. New regulations within 862-868 MHz should be taken into account in order to address all needs for new SRD applications;
5. Do not support a harmonisation of the extended GSM-R usage (only reflected in considerations of ECC/DEC/(04)06 [6] and ECC/DEC/(02)05) [7] since it would restrict too much the SRD duty cycles and require DAA for co-frequent RFID reader channels. The window of opportunity is closing for ER-GSM, with only Germany, Austria, Liechtenstein, Switzerland, and Hungary reported to be interested, and may not use the ER-GSM in all territory of their countries;
6. Do not mix the low power and higher power SRD regulatory framework within these frequencies.”

Considerable effort has been expended within CEPT over the past four years leading to two published ECC Reports:

- ECC Report 200 [9] (Co-existence studies for proposed SRD and RFID applications in the frequency band 870-876 MHz and 915-921 MHz);
- ECC Report 189 [8] (Future Spectrum Demand for Short Range Devices in the UHF Frequency Bands).

The socio-economic benefits of this spectrum have been shown for individual countries but the economies of scale from European harmonisation would be substantially greater.

ERC/REC 70-03 [5] as modified based on the proposals in ECC Report 189 offers various technical regulations applicable for countries which do not implement military applications in the frequency bands 870-876 MHz / 915-921 MHz. In addition, some countries have planned to deploy a GSM-R extension into the frequency bands 873-876 MHz / 918-921 MHz, at least in some areas where additional capacity is foreseen, such as some metropolitan stations, big shunting yards and national borders.

Further technical studies in CEPT in ECC Report 261 [10] have considered the demand for wideband SRDs (BW ≤ 1 MHz) based on IEEE 802.11ah [12] as well as the possible enhancement of existing regulations in frequency band 863-868 MHz and possible new use of frequency band 862-863 MHz by SRDs.

At present the range 863 to 870 MHz is used extensively for SRDs. However, a lot of new developments are anticipated, as set out in ECC Report 182 [17] (Survey about the use of the frequency band 863-870 MHz) and by ETSI in a set of System Reference Documents as detailed in ECC Report 189. This includes rising spectrum demands for generic SRD, UHF RFID, Home Automation & Sub Metering, Automotive SRD, Smart Meters and Smart Grids, Metropolitan Mesh Machine Networks (M3N) applications, Alarm and Social Alarm systems, and Assistive Listening Devices (ALDs including hearing aids). In addition, the bandwidth of the existing plans is limited to developing applications, e.g. a wider bandwidth for individual UHF RFID devices will improve their performance and function. With machine mesh networks, the required bandwidth of the systems would not fit into the existing narrow bandwidths that are available in the existing frequency band 863-870 MHz.

However, the monitoring campaigns carried out so far within CEPT (see section 2.1 below) did not find any evidence that there was any congestion in the range from 863-870 MHz.

Against this background, CEPT took account of two considerations:

- Firstly, in the American continent nearby frequencies (902 to 928 MHz) are designated to ISM (ITU-R Region 2 only), which is a convenient basis for using SRDs. ITU-R Regions 1 and 3 have never identified this band for ISM applications. A 915-921 MHz (or parts of it) SRD harmonisation presents an opportunity to align equipment availability with the Americas;
- Secondly, the frequency ranges have been identified as under-utilised in some countries in Europe: In those countries, these frequency ranges had been prepared for use by private mobile radio systems, but that development has seen very little take-up.

The CEPT survey in 2012 (in ECC Report 182 [17]) revealed a great variety in the EU countries' state of readiness for the release of these bands 870-876 MHz/ 915-921 MHz on a licence-exempt basis. It showed that the bands are partially or completely available in some countries, some countries use all or parts of the spectrum for governmental use, and a number of countries are reserving the 873-876 MHz/918-921 MHz spectrum for GSM-R, a primary service according to Article 5 ITU-R Radio Regulations (see section 2.6.2 and ANNEX 2:).

The CEPT survey in 2012 on CEPT countries' use of the two frequency bands 870-876 MHz and 915-921 MHz is summarised in the following Figure 1.

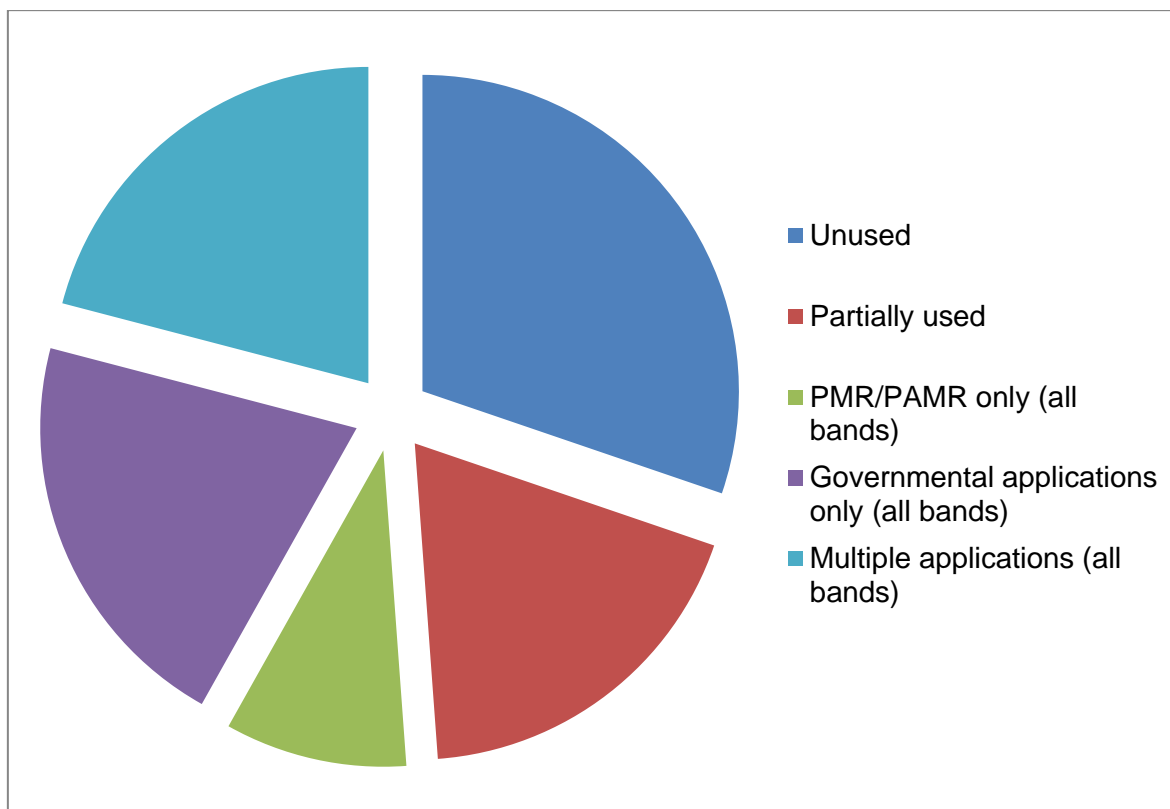


Figure 1: Usage of 870-876/915-921 MHz in CEPT countries in 2012

Other information set out the willingness of certain countries to consider a future new usage of these bands. This is reflected in the diagram in Figure 2 below:

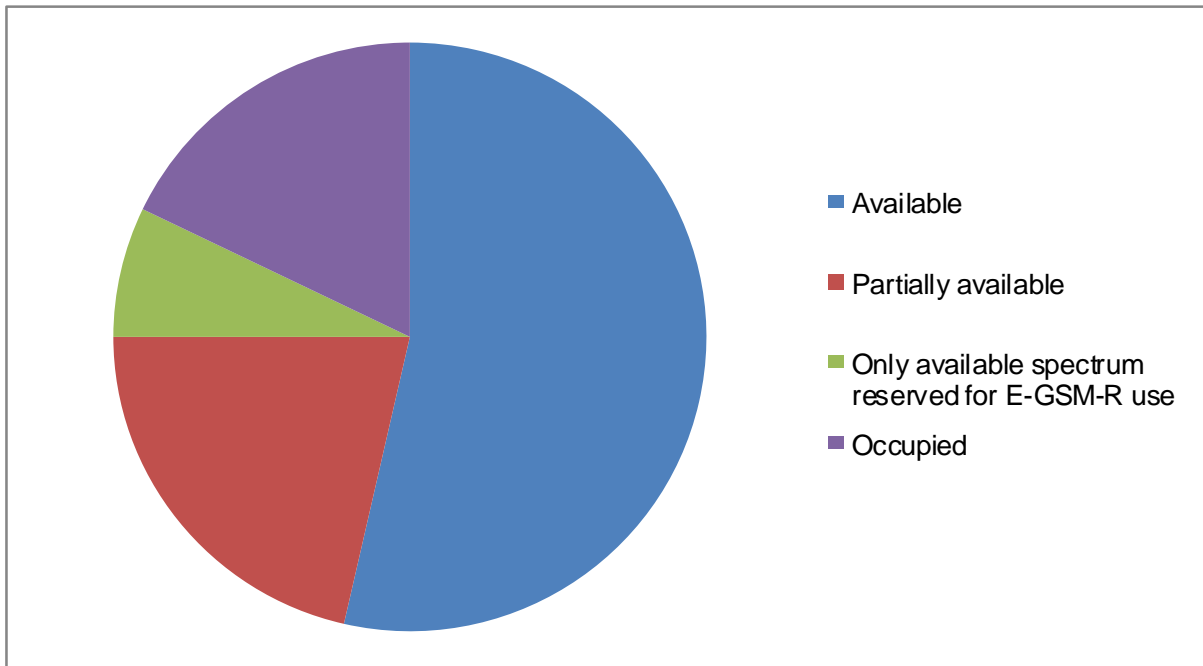


Figure 2: Willingness of certain Administration in 2012 to consider a future new usage

The range 862-942 MHz is important to NATO for military applications of the primary mobile service. Other sub-bands within the tuning range 610-960 MHz may also be used on a national basis according to the national requirements. This has come about due to the congestion of the NATO UHF band 225-399.9 MHz. It is categorised as class B: a NATO harmonised frequency band which fulfils important military requirements (see the NATO Joint Civil/Military Frequency Agreement (NJFA) 2014 [21]). The frequency bands 870-876 MHz and 915-921 MHz, all or parts of them, are used for defence systems in 11 CEPT countries (according to the survey in ECC Report 182 [17]). This includes for some of these countries, the use for unmanned military systems. In addition, some other countries anticipate needing to use the spectrum in some specific locations for an extension of the existing GSM-R bands. The studies in the ECC have covered this utilisation to provide a solution for spectrum sharing of some SRD applications with GSM-R.

This situation, when different countries implement different forms of application including governmental applications and/or defence applications, requires a particular approach to obtain a harmonised situation, where existing services remain protected to the extent that national administrations deem necessary, yet providing the opportunity for the harmonised development of new services in other European countries, where practical. The success of ERC/REC 70-03 [5] owes much to its 'soft harmonisation' approach, which is quicker to set up than a more rigid, centralised harmonisation process, where the measures needed to deal with important but limited incumbent interest can block or delay the process at the European level.

CEPT Report 14 [37] assessed the principle of market mechanisms as applied to SRDs and concluded 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.

The CEPT WGFM civil military meeting in 2013 noted the situation and endorsed this soft-harmonisation approach which was considered appropriate.

In some CEPT countries, including some Member States of the European Union, all or part of 870-876 MHz and 915-921 MHz are designated exclusively for military radio applications (see section 2.6.1). For harmonisation measures based on the Radio Spectrum Decision it has to be taken into account that it has to

be without prejudice to the right of Member States to organise and use their radio spectrum for public order and public security purposes and defence.

Possibilities for a flexible implementation are further discussed in this Addendum to CEPT Report 59 [1]

Based on ECC Report 189 [8] and conclusions from ECC Report 200 [9], ECC's SRD Maintenance Group defined regulatory frameworks for SRDs applications for CEPT countries where frequency bands 870-876 MHz and 915-921 MHz are unused. These regulatory frameworks are included in Recommendation ERC/REC 70-03 [5] in Annexes 1, 2, 5, 10 and 11. ECC Report 200 looks partly at the compatibility issues between different sorts of SRDs to investigate whether their use of the band is compatible with existing services. The existing implementation in CEPT countries is described in ANNEX 1. This development has also been supported by the publication of new or revised harmonised European standards.

This addendum investigates possibilities for European harmonisation in all or parts of the frequency bands 870-876 MHz and 915-921 MHz. This takes into account the regulatory ranking of the applications under discussion, the national sovereignty of EU Member States to organise and use their spectrum for public order and public security purposes and defence and the national implementations of the entries in annexes 1, 2, 5, 10 and 11 of ERC/REC 70-03 for these bands, also with respect to:

- The overall tuning range possibilities within (862)863-870 MHz, 870-876 MHz and 915-921 MHz;
- Further detailed assessment of the harmonisation needs;
- The results of additional compatibility studies which are in progress in CEPT at this stage and intending further liberalisations for the bands (862-868 MHz, 870-876 MHz and 915-921 MHz (ECC Report 246 [11] and ECC Report 261 [10]);
- Whether a more extensive harmonisation approach can also be split into successive steps in the future.

In order to preserve spectrum for radio services, as well as ensuring predictable sharing environment for SRDs, it is essential to focus on new requirements that cannot, or partially cannot, be accommodated in existing bands in order to support the demand for IoT services and recognising the emergence of network SRDs solution:

- Communication from smart metering terminals for their transmissions towards aircraft or satellite receivers;
- Wideband SRDs : WBN 25 mW / 1 MHz;
- Narrowband SRDs including elements such as NBN 500 mW / 200 kHz.

The demand for 'Lone worker applications' is also included, subject to better understanding of the deployment scenarios and effective limitation to low duty cycle and operation in critical conditions.

The regulatory proposal should also favour the use of frequency 915-921 MHz as it provides a potential for global harmonisation.

Visibility on the future availability of spectrum for primary users, in particular the military and the railway operators, is critical in this exercise.

Within the band 915-921 MHz, a solution for 4W UHF RFID interrogators should be offered in order to meet the long standing demand from industry. The 4 channels band plan also offers an opportunity for sharing with high power SRDs 500 mW. It is felt preferable to leave to EU Member States the possibility to authorise systems with registration/notification or on an individual authorisation basis pending the local demand and subject to the obligation to prevent harmful interference.

Enabling 25 mW wideband SRDs, consistent with global standards, seems also beneficial for the 915-921 MHz band. It is noted that technical studies in WGSE in ECC Report 246 are showing that 915.8-920.8 MHz is technically possible for WBN, not taking into account sharing with incumbent services.

Multiplying the number of regulatory layers for SRDs presents the risk of reducing sharing capability between SRDs. A more focused regulatory proposal that accounts for efforts to streamline the demand and key principles in frequency management for SRDs (i.e. focus on demand that cannot be accommodated in

existing bands, avoid mixing high / low power SRDs, enforcement matters) will support a more predictable sharing environment for SRDs.

The effective “tuning range” for the various SRD applications that are anticipated is supported by the relevant ETSI harmonised standards which offer broader options consistently with ERC/REC 70-03 [5]. This is needed to provide the necessary flexibility for national administrations for the precise implementation due to conditions imposed by radio service use.

Clear visibility is also required on the amount of spectrum that will be permitted on a general authorisation basis.

Administrations which have already authorised (or planned to) some data network solutions (e.g. narrow band high power) on an individual authorisation basis may document in the future the benefits in terms in additional capacity with respect to baseline harmonised spectrum.

This approach may give market participants assurance that CEPT administrations, seeing a solution for a future designation on international level continue their efforts for finding possibilities for partial or full national implementation in these frequency bands.

2 BACKGROUND

2.1 ETSI SRDOCS

At present the range 863 to 870 MHz is used extensively for SRDs. However, these ranges experience a growth in use and a lot of new developments are anticipated, as set out in ECC Report 182 [17] (Survey about the use of the frequency band 863-870 MHz); and by ETSI in a set of seven System Reference Documents, raising significant demand for additional UHF spectrum resources at 870-876 MHz and 915-921 MHz, covering the following SRD applications:

1. Generic SRD, RFID, Home Automation & Sub Metering and Automotive SRD, TR 102 649-2 [23];
2. Smart Meters and Smart Grids, TR 102 886 [24];
3. Metropolitan Mesh Machine Networks (M3N) applications, TR 103 055 [25];
4. Alarm and Social Alarm systems, TR 103 056 [26];
5. Assistive Listening Devices, TR 102 791 [27];
6. Wideband SRDs with advanced spectrum sharing capability, TR 103 245 [28];
7. Technical characteristics for Ultra Narrow Band (UNB) SRDs operating in the UHF spectrum below 1 GHz, TR 103 435 [29].

This includes rising spectrum demands for generic SRD, UHF RFID, Home Automation & Sub Metering, Automotive SRD, Smart Meters and Smart Grids, Metropolitan Mesh Machine Networks (M3N) applications, Alarm and Social Alarm systems, and Assistive Listening Devices (including hearing aids). In addition to capacity constraints, the bandwidth of the existing plans is limiting to developing applications, e.g. a wider bandwidth for individual RFID devices will improve their performance and function. With machine mesh networks, the required bandwidth of the systems would not fit into the existing narrow bandwidths that are available.

In addition to the above mentioned ETSI system reference documents, ETSI is supporting the standardisation of many technologies dedicated to M2M/IoT communications. Amongst those ETSI initiatives, it is worth noting the ongoing work on Low Throughput Networks (LTN) technical specifications ([53], [54]) which aim to define the associated use case & system requirements, architecture, protocols and interfaces.

All these technologies address the massive IoT market and will complement future cellular type networks. Cellular and other network technologies have different capabilities and a number of use cases could benefit from combining networks.

Although there is no real evidence of congestion in sub 1GHz spectrum at this moment the introduction of the newly proposed bands at 870-876 MHz paired with 915-921 MHz for short range device have the potential for delivering IoT applications.

2.2 CONSIDERATIONS ON THE DEMAND

The interest for UHF SRDs/RFIDs operating in the ranges 870-876 MHz and 915-921 MHz has been indicated on CEPT level, especially by submitting seven SRdocs (see section 2.1) and by responding during the public consultation of draft CEPT Report 59 [1] (see ANNEX 5).

Harmonisation is important to ensure that sufficient spectrum resources are available to allow SRD and RFID applications to continue to provide an acceptable QoS, to continue to develop innovative applications and to provide a firm and clear message to industry about spectrum opportunities. It will enable new innovative applications of the Internet of Things (IoT) in Europe such as next-generation RFID, smart metering & smart metropolitan and rural area networks, home automation, social and fire alarms as well as related emerging technologies such as wideband technologies. Increased economies of scale will ultimately reduce the cost of services or are necessary to actually make some applications viable.

The current versions of national frequency usage plans do not contain in all CEPT member administrations a designation for SRDs/RFIDs in these frequency ranges. However, amendments and updates of the frequency table always require – at least according to EU law in EU Member States – a public consultation. Some countries reported that they have not received strong requests for adding a spectrum designation for SRDs/RFID in these frequencies during the generic consultation processes for updates of the national frequency table. The existing implementation information is provided in ANNEX 1:. In addition, some countries conducted specific consultations, see information in ANNEX 4:.

The wish to harmonise spectrum in the band 915-921 MHz is also triggered by ITU RR footnote 5.150. With that footnote, the band 902-928 MHz is “*also designated for industrial, scientific and medical (ISM) applications*” in ITU Region 2 only, and this ISM band has also been made available for SRDs in ITU Region 2. Nevertheless, the SRD industry wishes to make use of this band for SRDs in Europe, too. In Region 3, the band is available in some countries for SRDs, but also not on a harmonised basis. The 902-928 MHz band was originally for ITU-R Region 2, however, it does get copied around the world, in particular in Australia and New Zealand. It is also becoming widespread across Asia, in particular for RFID, such as in Singapore, Vietnam, Malaysia and Japan. There are also aspects of it in South Africa, and other countries, normally mixing European and American regulations. In some countries, such as In China (Mainland), the 905-925 MHz band can be allocated to the aeronautical radionavigation service on a secondary basis. The 925-930 MHz can be allocated to the aeronautical radionavigation service on a primary basis which shall be afforded protection from harmful interference by other services and applications. Some Asian countries use the band for PMR trunking, Conventional telemetry, SCADA etc.

One has to be careful however in determining the technical usage parameters for these bands and not adapt the usage parameters of ITU Region 2 since this band is used in Region 2 with the available frequency space is much larger than it could possibly be envisaged for in Europe.

In addition, the proposals made in Annex 3 are considered to be as technology-neutral as possible, enabling future innovation and flexibility with regard to how services can be offered. It should be understood that the proposals made in this Report are a result of the information contributed to work in CEPT so far and that it is expected that further contributions will be made in the future. As such, changes may be possible in the future and may be considered as relevant information becomes available. In the 915-921 MHz, there is an opportunity to better define the RFID interrogator signal than was previously permitted in the more limited bandwidth at 865-868 MHz. The wider bandwidth allows for the RFID signal to be widened to 400 kHz and the power increased by 3dB over the RFID allocation at 865-868 MHz. This better defined RFID signal allows for higher data rates and greater penetration into pallets containing large numbers of tagged goods and so a successful tag read becomes more likely.

The wish to harmonise the band 870-876 MHz for SRDs is not triggered by a similar situation. The band 870-876 does not belong to an ISM band. It is worldwide allocated to the fixed and land mobile service on a primary basis, and for example in the US designated to Public Mobile/Private Land Mobile applications according to FCC Rule Parts 22 and 90. Thus, a worldwide availability of the band 870-876 MHz for SRDs is difficult to achieve, even in case a harmonisation for SRDs would be introduced in Europe. The UAE has recently adopted CEPT/ETSI rules in both 870 and 915 MHz. However, many Asian countries use the band for IMT.

The European Commission issued a study on the “Identification of the market for radio equipment operating in licence-exempt frequency bands to assess medium and long-term spectrum usage densities” (SMART 2014/0012). The final report concluded: “The introduction of 915-921 MHz as a mandated spectrum band for SRDs would increase harmonisation with the US and open opportunities for increased economies of scale for SRDs and with potentially significant increases in RFID deployments.”

The UK Spectrum Policy Forum Report, 2015, Future Use of Licence Exempt Radio Spectrum [41] indicating an insufficiency of spectrum to support the capacity needs of sectors experiencing and expecting substantial growth in demand.

Research in The Netherlands:

In The Netherlands a number of investigations in the licence exempt spectrum were commissioned:

- The first investigation [42] was focussed on 2.4 GHz and 5 GHz as use in the 2.4 GHz progressively increases. The main question was if measures need to be taken to free more spectrum in these bands. An important recommendation was not to focus on the 2.4 GHz band but use the 5 GHz band if possible and be more efficient in the frequency space available. This report does not address the sub 1 GHz frequencies but an important general lesson may be learned. Use of all the spectrum available and use it efficiently before making more spectrum available. A sub effect is the need for innovation to make use of this spectrum in increasingly more difficult sharing scenarios. The Report published in 2016 by the Body of European Regulators for Electronic Communications (BEREC) [43] contains an interesting quote in relation to this *“There is no one, single description of the spectrum requirements for IoT services; rather, the spectrum requirements for a given IoT service will be heavily influenced by the specific nature of that service.”* From this one may conclude that making sub GHz spectrum available solves only some application specific issues.
- The second Dutch report [44] was about the spectrum impact of IoT, this report concludes that sub 1GHz spectrum is crucial for the success of smart city scale IoT applications, again a specific scenario. It also advises to make only spectrum for general use available without application specific segmentation but to limit its use (through for example DC and power limitations) to provide a high degree of availability for critical applications. The general approach in the 870-876/915-921 MHz with safe havens and strict DC and power limitation without any exception is the right way to achieve this.
- The third report [45] deals with market volumes of licence exempt devices in sub 1 GHz, 2:4 GHz and 5 GHz spectrum. The research was focused on the prediction of growth based on sold chips and chipsets for these applications. For sub GHz spectrum namely for the 863-870 MHz band it is expected that growth will take place but mainly for M2M and IoT applications.
- The fourth report [46] is also mentioned in the Dutch national section in ANNEX 4: with its main conclusion not to make additional spectrum available for IoT applications below 1GHz while the previous Dutch reports show that the growth and additional spectrum requirements are mainly caused by these applications. It can be concluded that the need for additional M2M and IoT spectrum from a user point of view is strongly driven by national operators and not by individual SRD users. The report also acknowledges the need for harmonised spectrum for RFID in the 915-921 MHz band.

The general conclusions from these above mentioned reports are:

- make RFID spectrum worldwide harmonised in the 915-921 MHz band;
- provide spectrum for IoT and other networked applications but do this in a flexible way since national demand varies significantly;
- do not make additional spectrum available for general use at this moment below 1GHz but focus on the higher frequencies.

In the RSPG Report on ‘Strategic Sectoral Spectrum Needs’ for smart energy grids, smart meters, ITS and IoT (including RFIDs and M2M), the RSPG has identified no requirements that would motivate a harmonised European solution for dedicated spectrum for specific services or applications. However, the large predicted growth within some of these analysed sectors contribute to an increased need and demand for capacity and bandwidth, which may be met in suitably expanded future identification of bands under general authorisations (exemption from individual licensing). The future spectrum needs for smart energy grids, smart meters, ITS and IoT (including RFIDs and M2M) can be addressed via the ETSI-CEPT process. For these solutions, several existing spectrum options have been identified by the RSPG, including 169.4-169.8125 MHz, 868-870 MHz, and 870-876 MHz and 915-921 MHz, under SRD regulations.

ECC (FM22) has had carried out three monitoring campaigns so far with regard to the usage of spectrum for SRDs. The goal of the campaigns was to obtain information about the use of the 863-870 MHz frequency band. The additional goal for the third campaign was also to find trends in the usage of the frequency band 863 to 870 MHz (see document FM(11)071, input to WGM#72, May 2011) [19].

The monitoring campaigns have shown that there are typical differences in the geographical spreading of signals in the 863-870 MHz band. The lower part of this band (863-865 MHz), mostly used for instance for

wireless audio, is crowded in the cities, as the RFID frequencies (in 865-868 MHz) are mostly used in industrial areas like harbours and large shopping malls.

An important goal of the third monitoring campaign 863-870 MHz was to have an insight in the development of the usage of this frequency band over the period 2008 to 2011. Visualisation of the trend in the different bands was made by histograms.

The results have shown that the 865-868 MHz sub-band was unoccupied in most cases and that the 868-870 MHz sub-band was only slightly less occupied than the 863-865 MHz sub-band. The 869.4-869.625 MHz channel with 500mW was heavily occupied.

The participating administrations did not find evidence that there was congestion. Also the measurement results over the three phases only have shown a small change in occupancy figures.

ECC Report 182 [17] shows that the range 863 to 870 MHz is used extensively for SRDs. A lot of new developments are anticipated, as set out in ECC Report 182 (Survey about the use of the frequency band 863-870 MHz) and by ETSI in a set of System Reference Documents as detailed in ECC Report 189 [8]. This includes rising spectrum demands for generic SRD, UHF RFID, Home Automation & Sub Metering, Automotive SRD, Smart Meters and Smart Grids, Metropolitan Mesh Machine Networks (M3N) applications, Alarm and Social Alarm systems, and Assistive Listening Devices (ALDs including hearing aids). In addition, the bandwidth of the existing plans is limited to developing applications, e.g. a wider bandwidth for individual UHF RFID devices will improve their performance and function. With machine mesh networks, the required bandwidth of the systems would not fit into the existing narrow bandwidths that are available in the existing frequency band 863-870 MHz.

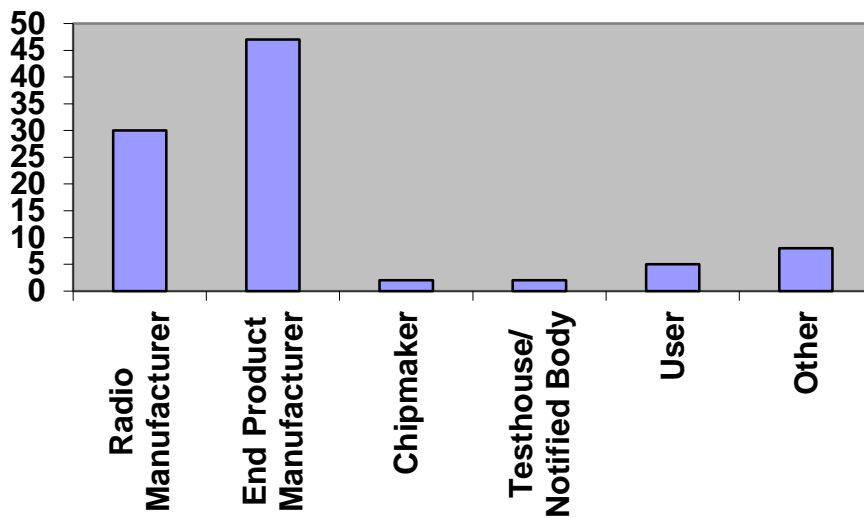


Figure 3: Responders to the Survey in ECC Report 182 in 2010/11

The following minimum numbers of devices operating in 863-870 MHz sold annually amongst application fields from the above responses can be assumed conservatively as follows (this only includes those who provided an answer and does not represent the whole market, i.e. the real numbers in the market are likely to be higher. For example, the current device population in 2010 for social/personal alarms was estimated to be around 3 millions):

All kinds of Metering:	> 10 millions
Home automation (incl. all kinds of remote controls)	> 10 millions
Alarms (incl. intrusion sensing)	> 10 millions
Automotive	> 5 millions
Industrial, including sensors in industry	> 2 millions

Audio	> 2 millions
RFID	> 100 000 readers with millions of tags
Social/personal alarms	> 100 000 units annually.

The above is only to show the approximate weighting of the respective application field as represented in the responses. It is also to note that many answers indicated that they see a strong growth of their respective wireless device sector. Such statements were made across all the above application fields.

It was noted a large number of responses were related to smart metering and recommended to consider expansion of spectrum usage possibilities for the metering segment or similar networked SRDs in the M2M/IoT sector.

A number of forecasts expect the IoT/M2M traffic in wireless networks to quadruple within the 2015-2022 timeframe as was reported by several sources during the CEPT M2M Workshop in March 2016, carried over cellular networks as well as low power local and wide area networks. This will cause pressure on the current use in frequency bands, especially below 1 GHz. Spectrum usage below 1 GHz may be complemented in the future with higher frequency bands. The demand would be for unlicensed as well as individually licensed spectrum. The difficulty is that such forecasts showing an increase of traffic (or number of devices) cannot always be translated into increase of spectrum demand for a specific solution and frequency band.

According to the Rain RFID Alliance, the number of delivered UHF RFID tags exceeded 10 Billion in 2016 with volume growth rate more than 70%. RFID UHF technology is approaching the consumer market as well with RFID enabled smartphones already available in the market. Major industries like retail, airlines, automotive, food service rely on UHF RFID for business-critical operations. RFID operation in the 915-921 MHz band in Europe would naturally strengthen Europe's position as integral part of global supply chains.

The CEPT Workshop concluded that solutions would be for short range / long range communication, including also meshed network, ad-hoc network solutions, and some very asymmetric network solutions where network relay points and individual sensors/actuators may need to be treated differently in frequency regulation.

Concerning unlicensed use, there was a strong request for more harmonisation in 870-876/915-921 MHz at the CEPT Workshop. It was recognised that there was also the need to find a balance between national flexibility and the right level of EU harmonisation. It was in particular determined that the 870-876 and 915-921 MHz bands are underused in most European countries according to ECC Report 189 [8], but designated for other radio services applications (ER-GSM, governmental applications) in a number of countries.

It can be summarised for sections 2.1 and 2.2, that the wish for harmonisation of additional spectrum in the 800/900 MHz range for SRDs/RFIDs is backed up by the requests from stakeholders through the ETSI-ECC collaboration process in seven ETSI SRdocs, and market surveys such as in in ECC Report 182 [17] and other studies, including traffic forecasts for M2M/IoT applications, and by the aspect that the bands 870-876 MHz/ 915-921 MHz are underused in many CEPT countries; however the interest is not based on evidence of a current lack of spectrum in the range from 863-870 MHz, and – when considering a potential wider geographical harmonisation - mainly but not only the upper band only (915-921 MHz) is addressed.

2.3 STREAMLINING THE DEMAND

Taking into account the diversity of the demand, it seems important to streamline the demand since:

- the demand for automotive applications (ERC REC 70-03 [5] Annex 5 band a) has not been confirmed;
- the demand for audio applications in 915-921 MHz seems also limited and has not been confirmed. Therefore, it is proposed to not consider a regulatory framework in the band 915-921 MHz for audio applications as described in ERC/REC 70-03 Annex 10. This streamlines the demand;
- when reviewing spectrum requests for different SRD applications, CEPT offers a larger frequency band as requested in ERC REC 70-03. Even if compatibility studies demonstrate that low power and high power SRD can coexist, under certain conditions, in a same frequency band, this may create a

future challenging situation in the case of, for example, high power SRDs are deployed with densities higher than expected. Noting in particular, that the request for NRP, Access point or MRAN (“all network nodes”) – beside other requests carried in the other ETSI SRdocs, the request was based on 3 MHz, it may seem to be unnecessary to provide 6 MHz of spectrum to address this request in parallel to an SRD low power regulation. Hence, consideration could be given to separate higher and lower power SRD applications in order to not mix systematically a low and high power SRD regulatory framework within the same frequency bands. However, ECC Report 200 [9], ECC Report 246 [11] showed how high- and low-power applications can coexist with one another;

- taking into account on-going activities within CEPT on re arranging the frequency regulatory framework within 862-868 MHz, in particular the new opportunities in 865-868 MHz, it should be assumed that this provides a further new opportunity and in that extent this spectrum range should be considered in addition to the new UHF frequency bands 870-876 MHz and 915-921 MHz in order to address the need for all SRD applications. On the other hand, scenarios are different between existing spectrum and new spectrum (this is a macro scenario encompassing 865-868 MHz, 870-876 MHz, and 915-921 MHz). As indicated before, a geographical sharing option as well as technical mitigation option (lower DC for SRDs, UHF RFID with DAA) for the protection of ER-GSM should be an option in this overall approach.

2.4 AVAILABLE STUDIES IN CEPT

ECC Report 200 gives the background and conclusions to a comprehensive set of coexistence studies in these UHF bands in Europe between SRDs application and some radio services. It has to be underlined that starting from the conclusions included in ECC Report 200, governmental applications have been excluded from the further investigations noting that the results are that only limited coexistence is possible with such application.

Some of the studies used the ECC’s SEAMCAT analysis tool. The related ECC Report 189 [8] used these conclusions to define recommended regulatory parameters for SRDs excluding the consideration of governmental applications. This report was used to form part of the ECC’s key regulatory document on SRDs, ERC/REC 70-03 [5]. ECC Report 200 [9] looks partly at the compatibility issues between different sorts of SRDs to investigate whether their use of the band is compatible with some existing services. However, the major part of the report recognises that although under-utilised for Professional Mobile Radio (PMR), there are existing governmental services (including defence applications) with access to part of the new frequencies in 11 CEPT countries which would need protection in the future at the discretion of the relevant national administrations. The review included an audit of these existing and planned uses, which revealed not only some of the military tactical systems as known about, but also some new uses such as remote control of unmanned aircraft (UAV). It has to be noted that this part of the UHF spectrum is the only spectrum which could be assumed as harmonised for governmental applications in Europe noting the propagation performances of UHF bands for all type of applications (as emphasised notably by SRD industries). Some other countries anticipate needing to use the spectrum in some specific locations for an extension of the existing GSM-R bands. The studies in the ECC have covered this utilisation to provide a solution for spectrum sharing with GSM-R.

ECC Report 200 also describes the use of network access points/network relay points forming part of metropolitan area ‘mesh’ networks for utilities or other applications for the purpose of data acquisition for example.

Network relay points can be operated by various providers in the same metropolitan area and are recommended to be individually authorised by the administration, although registration/notification can also be an option under general authorisation framework if such network relay points provide for a more polite spectrum access. This means that it is not intended to limit the number of M/RAN (Metropolitan/Rural Area Network) in a given area a priori and that the principles as set out in CEPT Report 44 [30] should apply, such as equal access to the spectrum, on a shared basis, in a technical and application-neutral manner. Further technical measures are not recommended at the moment but may be subject to review, should traffic overload situations materialise in the future.

2.5 ONGOING STUDIES

This section describes ongoing studies in order to define a stable regulatory framework and tackle remaining coexistence issues which may be addressed in future revisions of the technical annex of the European Decision on SRDs. The following sub-sections in this chapter include only those items for which a sufficient consensus has been achieved within ECC.

2.5.1 Results from ECC Report 246 on the frequency ranges 870-876MHz and 915-921 MHz

ECC Report 246 [11] was published in January 2017.

- a.) Studies have shown that the DC limits can be increased for 25 mW non-specific SRDs from 1% to 2.8%. This concerns the existing entries h2.1 (band 870-875.8 MHz) and h3.1 (band 915.2-920.8 MHz) in ERC/REC 70-03 [5] Annex 1 (non-specific SRD) where the DC limit can be increased.
- b.) Possibility to define a new opportunity for new emerging wideband SRD applications (25 mW, 1MHz bandwidth, DC up to 10% and LBT for network APs, DC up to 2.8 % for terminal points) in the bands 870-875.8 MHz and 915.8-920.8 MHz. The studies have indicated the protection of public cellular systems is achieved if both of the following assumptions are fulfilled:
 - A lower edge for IoT WB SRD tuning range is set to 915.8 MHz;
 - WB SRD unwanted emissions comply with Mask Option 1 (see ANNEX 1: in ECC Report 246), i.e. compliant with -54dBm/100kHz limits in the spurious domain.
- c.) The three uppermost RFID interrogator channels in the band 915-921 MHz may be used by NBN (up to 500 mW, 200 kHz channels, i.e. three times two 200 kHz channels) with respect to the considered systems. The potential use of NBN in the first RFID interrogator channel requires additional study with regard to co-existence with public mobile networks.

GSM-R reception above 921 MHz could be protected from the introduction of NBN in the RFID interrogator channels by applying mitigation techniques at a national level, e.g. separation distance close to railway installations. SRD transmitting below 876 MHz may interfere GSM-R BS receiving above 876 MHz, in case of uncoordinated deployment. Additional information about the possibilities of interference from NBN SRD and RFID into GSM-R, as well as possible measures to overcome local problems, are provided in Annex 6.

These possibilities can be facilitated by new entries or amended entries in ERC/REC 70-03.

It is proposed to include opportunities **b.** and **c.** in the harmonisation approach of the EC Decision for SRDs.

Due to the following considerations:

- Do not mix the low power and higher power SRD regulatory frameworks ;
- In order to preserve spectrum for radio services, as well as ensuring a predictable sharing environment for SRDs, it is essential to focus on new requirements that cannot, or partially cannot, be accommodated in existing bands in order to support the demand for IoT services and recognising the emergence of networked SRDs solutions;
- Multiplying the number of regulatory layers for SRDs presents the risk of reducing sharing capability between SRDs. A more focused regulatory proposal that accounts for efforts to streamline the demand and key principles in frequency management for SRDs (i.e. focus on demand that cannot be accommodated in existing bands, avoid mixing high / low power SRDs, enforcement matters) will support a more predictable sharing environment for SRDs,

It is not proposed to include a proposal for non-specific SRDs with 25 mW and DC of up to 2.5% in the harmonisation proposal in this Report. In this context, it should be noted that the proposed new entry for wideband SRDs may give some flexibility to standardisation to accommodate as many applications as possible in the scope of the harmonised standard for wideband SRDs (including SRD equipment with 25 mW and DC of up to 2.5%, same parameters as for terminal points of wideband SRD installations) and that this may be the right starting approach for new innovative applications, especially in bands with the opportunity for wider than European harmonisation.

It should be noted that the 3GPP recently specified IoT (EC-GSM-IoT, LTE-eMTC, NB-IoT) are ready soon for deployment. ECC Report 246 [11] therefore did not have the chance to consider these technologies, but did so on the basis of existing standards.

2.5.2 Results from ECC Report 261 on the frequency range 862-868 MHz

ECC Report 261 [10] has been published in January 2017.

862-863 MHz

In principle, SRD vendors wishing to use the band 862-863 MHz should weigh the risks and accept responsibility for deciding themselves whether their specific applications shall be capable of operating in the presence of comparatively high ambient noise levels from LTE UEs' out-of-band emissions and design their products accordingly.

In a survey in 2012 [15], 35 CEPT administrations saw a possibility for SRD use in this band. Due to the fact that eight CEPT administrations have governmental services, partially highly classified in the band and with no time limitation, it is proposed that this band can be added to the harmonisation approach as long as the SRD applications within this band are based on installations (e.g. home automation, metering, industrial, all kind of non-specific new innovative IoT/M2M applications which are networked) to avoid 'spill over' to the concerned countries with governmental use, or, as an exception from this rule, use a very low DC limit of 0.1%. This possibility seems justified also taking into account the aspect of the already existing interference contribution from LTE UE's in to this band based on the LTE UE's transmitter mask as defined by ECC/DEC/(09)03 [16]. However, the benefit of such an opportunity in addition to existing regulations was questioned, also noting that in the 862-863 MHz the presence of comparatively high ambient noise levels from LTE UEs' out-of-band emission. In addition, some CEPT administrations have governmental services in this frequency range. A harmonisation proposal for non-specific SRDs with 25 mW e.r.p. and maximum duty cycle of 0.1% is therefore not proposed in this Addendum.

No new harmonisation opportunities are proposed for the band 862-863 MHz at this time.

ECC Report 261 indicates that non-specific SRD devices with e.r.p. of up to 25 mW and DC of up to 0.1% and with 350 kHz bandwidth were shown to have minimal interference to cordless audio devices in 863-865 MHz and to LTE under the condition that the transmitters use the emission mask Option 1, making their implementation feasible, i.e. compliant with -54dBm/100kHz limits in the spurious domain.

In addition, ECC Report 261 indicates that operation in the band 862-862.4 MHz should be restricted to terminals with 500 mW e.r.p, low duty cycle (0.1%) and to terminals with 100 mW e.r.p, low duty cycle (0.1%) in the band 862.4-863 MHz, within specific networks (e.g. smart metering in rural or remote area and low density deployments). In all cases, the emission mask Option 1 is required for these terminals, i.e. compliant with -54dBm/100kHz limits in the spurious domain. However, further considerations are needed.

New narrowband networked SRD (data networks) in the band 862-863 MHz would require stringent restrictions of the duty cycle of such devices according to ECC Report 261, in order to achieve compatibility with incumbent applications in adjacent bands (MFCN, cordless audio, hearing aids). Simulations indicated that implementation of narrowband networked SRD could create a high probability of interference to LTE base stations below 862 MHz and audio applications above 863 MHz. No proposal for harmonisation is made in this Addendum for such networked SRDs used for data acquisition.

New wideband SRD in the band 862-863 MHz were also studied in ECC Report 261. Wideband SRD applications do not cause harmful interference to adjacent LTE operations below 862 MHz on the condition the transmitters use the emission mask Option 1, i.e. compliant with -54dBm/100kHz limits in the spurious domain. Furthermore, although the studied worst case scenario to ensure protection of LTE 10 MHz channels operating below 862 MHz resulted by the emission mask Option 1, some stakeholders were of the opinion that an additional restriction of 800 kHz guard band may need to be implemented between the frequency 862 MHz and the wideband SRD lower band edge (i.e. 862.8 MHz). Given the minimum required channel bandwidth of 1 MHz, this effectively means that wideband SRD should not be introduced in 862-863 MHz.

Opportunities in 862-863 MHz for SRD will be considered by a technical harmonisation approach in ERC/REC 70-03 [5].

However, it has to be taken into account that several CEPT administrations have governmental services in the band 862-863 MHz, partially highly classified, and with no time limitation, which need to be protected.

Harmonisation possibilities for the band 862-863 MHz are proposed to be further discussed in the 7th update process for the EC Decision for SRDs.

863-865 MHz

The SEAMCAT simulations in ECC Report 261 [10] have shown that WBN SRD applications may coexist with cordless audio applications in this band, even, as conservative approach, without introducing polite spectrum access technique such as CSMA/CA or equivalent as mitigation in the SEAMCAT simulations. Some audio manufacturers noted that practical tests have not been conducted.

The above discussed results of potential impact to cordless audio and hearing aids as victim did not take into account the use by WBN SRD of CSMA/CA mitigation mechanism. On the other hand, if in the future such WBN SRD applications become truly widespread, it would be quite possible for these devices to be present in even higher densities, i.e. the same number of simulated devices would be concentrated in a smaller area. Therefore the importance of using mitigation such as CSMA-CA or equivalent is very important.

Cordless audio manufacturers noted and expressed concern that practical tests were not conducted however, it was considered by other parties that such tests were not obligatory. However, the use of LBT or equivalent technique may facilitate more reliable use of the spectrum in particular in order to mitigate any potential interference to cordless audio devices. Considering the issue of compatibility with the LTE below 862 MHz, simulations indicated that wideband SRD operating in 863-865 MHz need to meet the emission mask Option 1 in order not to cause harmful interference to LTE below 862 MHz, i.e. compliant with -54dBm/100kHz limits in the spurious domain.

It is considered that an opportunity for WBN SRD applications can be facilitated by a new entry in ERC/REC 70-03 [5]. It is proposed to include these opportunities in the harmonisation approach of the EC Decision for SRDs.

Although SEAMCAT simulations in ECC Report 261 have shown that additional NBN SRD 500 mW applications may coexist with cordless audio in the band, practical tests have been carried out showing that this coexistence would be difficult because of the expected to 100% duty cycle nature of audio systems. This band is therefore not recommended for harmonisation for NBN SRD.

For the worst case in ECC Report 261 of all simulated NBN SRD network devices operating at their maximum DC and at highest assumed deployment density, the impact to LTE Uplink operations would be up to 13-20% if NBN SRD were deployed in 863-865 MHz.

865-868 MHz

- Access points/ base stations of NBN SRDs (data networks) are able to operate on the UHF RFID interrogator channels (4 x 200 kHz) with up to 500 mW.

Considering the results of simulations and recognising that this kind of operation would be more than 3 MHz offset from the LTE upper edge, it appears that implementation of NBN networks within "RFID interrogator channels" may create acceptable probability of interference to LTE base stations below 862 MHz.

This can be facilitated by new entries in ERC/REC 70-03, similar to the existing entry for MRANs.

No consensus could be reached so far with regard to MRANs are able to operate throughout the band 865-868MHz without causing harmful interference to Low Power Wide Area Networks (LPWAN), although interference to standard 25mW SRDs would not be expected.

When considering LPWAN applications (e.g. LORA) in the band 865-868 MHz, which are in current use within Europe (see section 2.3.7 of ECC Report 261), the available studies up to now show that sharing

between NBN SRD networks and Low Power Wide Area Network (LPWAN) in the same frequency band should be restricted to RFID interrogator channels and to NBN deployment as described in section 2.5.1 of ECC Report 261. Studies related to the impact of LPWAN NAP/NN into NBN as well as into other SRDs are not presented in ECC Report 261 [10].

- New wideband SRD applications (25 mW, 1MHz bandwidth, DC up to 10% and LBT for network APs, DC up to 2.8 % for terminal points) are able to operate across the entire band 865-868 MHz.

It should be noted that the 3GPP recently specified IoT (EC-GSM-IoT, LTE-eMTC, NB-IoT) are ready soon for deployment. ECC Report 261 [10] therefore did not have the chance to consider these technologies, but did so on the basis of existing standards.

These opportunities will be set out in ERC/REC 70-03 [5].

It is proposed to include these opportunities in the harmonisation approach of the EC Decision for SRDs once these opportunities are confirmed in the ECC Report 261.

2.6 RADIO SERVICES IN THE BANDS 870-876 MHz AND 915-921 MHz

2.6.1 Military applications

In the past the range 790-960 MHz was identified for military applications (according to the NATO Joint civil/military Frequency Agreement (NJFA) 2002 ²). Because of the CEPT-wide deployment of MFCN and SRDs and – in some countries – also GSM-R in this range, the remaining part for military applications which is usable for critical military applications has been shortened to 870-876 MHz and 915-921 MHz (and on national level even only parts of these bands). The 870-876 / 915-921 MHz bands (or part of it) are the only ‘exclusive military’ band left in UHF, which are not shared yet in some countries, see NJFA [21].

The latest version of ERC Report 25 (ECA Table) [18], as finally approved by WG FM in May 2016, also designates the bands 870-876 MHz and 915-921 MHz for land and maritime military systems. The NJFA (2014) [21] was taken into account for the revision of ERC Report 25. That designation is reflected in EFIS (www.efis.dk, see applications) and/or the national allocation tables.

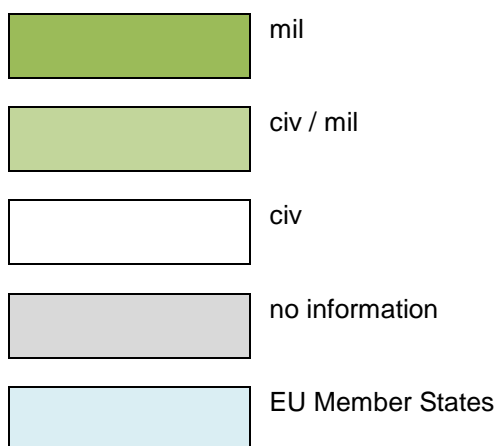
Table 1: Current military usage according to EFIS or national allocation tables

	862-870 MHz	870 – 876 MHz	915 – 921 MHz
Albania			
Andorra			
Austria			
Azerbaijan			
Belarus			
Belgium			
Bosnia and Herzegovina			
Bulgaria			
Croatia			
Cyprus			
Czech Republic			
Denmark			
Estonia			
Finland			
France			
Georgia			
Germany ³			

² See document FM38(05)Info02

³ In Germany, the spectrum within 870-873 MHz and 915-918 MHz is used by military applications. However, according to the national allocation table the whole range from 862-960 MHz is shared by the civil and military side.

Greece			
Hungary			
Iceland			
Ireland			
Italy			
Latvia			
Liechtenstein			
Lithuania			
Luxembourg			
FYROM			
Malta			
Moldova			
Monaco			
Montenegro			
Netherlands			
Norway			
Poland			
Portugal			
Romania			
Russian Federation			
San Marino			
Serbia			
Slovak Republic			
Slovenia			
Spain			
Sweden			
Switzerland			
Turkey			
Ukraine			
United Kingdom			
Vatican State			



In a number of CEPT countries (e.g. Germany, France, Netherlands, Greece) the bands 870-876 MHz and 915-921 MHz or parts thereof are designated exclusively for military radio applications and therefore it cannot be expected that they can be made available e.g. for short range device applications for the present.

According to Article 1 (4) Decision No 676/2002/EC [4] of the European Parliament and of the Council of 7 March 2002 on a regulatory framework for radio spectrum policy in the European Community (Radio Spectrum Decision), harmonisation measures based on the Radio Spectrum Decision has to be without prejudice to measures taken at Community or national level, in compliance with Community law, to pursue general interest objectives, in particular relating to content regulation and audio-visual policy, to the

provisions of Directive 1999/5/EC and to the right of Member States to organise and use their radio spectrum for public order and public security purposes and defence.

This includes avoiding harm on respective usages on national level.

Any future EU harmonisation measure has to ensure that neither an implementation on national level has to be mandatory what could affect that national sovereignty, nor must such a harmonisation measure lead to a situation that the free circulation and use of equipment in Europe might cause effects on these military usages in the mentioned countries.

Noting this situation, the issue was discussed during the CEPT/WGFM civil/military meeting in November 2013. The meeting concluded for SRDs in the band used for military applications:

'The meeting noted the approach taken by the ECC for the harmonisation of SRD applications in the UHF bands 870-876/915-921 MHz in ERC/REC 70-03 [5] (used by 11 administrations for military applications in all or parts of the bands). This "soft-harmonisation" approach was considered appropriate. It provides a good example of the ECC's use of 'soft harmonisation', where existing services remain protected to the extent that national administrations deem it necessary, yet providing the opportunity for the harmonised development of new services in the majority of European countries. Administrations can freely decide which part of the ERC/REC 70-03 new entries they can implement – in line and in balance with incumbent use. It was further noted that this approach could also be implemented with respect to the SRD in the other frequency bands and used for the military applications.'

The issue was discussed again at the CEPT/WGFM civil/military meeting on 23-24 November 2016. Diverging positions from national administrations and stakeholders on this topic were expressed. In the discussions, amongst other aspects, the following aspects were raised:

- To consider the legal framework on EU level (Radio Spectrum Decision, article 1.4);
- Only limited parts of the bands may be usable for SRD/RFID on national level in countries with military use or ER-GSM use.

2.6.2 Extension band for GSM-R

According to ECC/DEC/(04)06 [6] (considering-e), the band 873-876 MHz UL / 918-921 MHz DL can be made available on national level for an extension of GSM-R. This is the ER-GSM band. This is in line with the statement given in ECC/DEC/(02)05 [7] (see considering-h). With these amended Decisions, CEPT/ECC responded to the request as submitted by ETSI with the System Reference Document ETSI TR 102 627 in 2007 [14].

The ER-GSM band has been covered by the relevant 3GPP standards since Release 12 (see 3GPP TS 45.005 [20]) in September 2013. Currently the revisions of the ETSI EN are performed to reflect the latest changes in the regulatory domain (to fulfil the requirements of the RE-D).

ETSI EN 301 502 V12.5.1 [32], relevant for GSM and GSM-R base station requirements, was published in July 2016. This version also includes the conditions for the GSM-R extension band (ER-GSM). The latest draft version of amended ETSI EN 301 511 [33], relevant for GSM and GSM-R user equipment, also includes the conditions for the GSM-R extension band (ER-GSM).

Commission Regulation (EU) 2016/919 of 27 May 2016 [50] "on the technical specification for interoperability relating to the 'control-command and signalling' subsystems of the rail system in the European Union" shall be binding in its entirety and directly applicable in all Member States. This Commission Regulation refers to the EIRENE (European Integrated Railway Radio Enhanced Network) specifications; see Tables A2.1, A2.2 and A2.3 on mandatory specifications. The EIRENE SRS v16.0.0 (System Requirements Specification) [47] and FRS v8.0.0 (System Requirements Specification) [48] both define requirements for the network equipment and the user equipment.

EIRENE SRS v16.0.0 [47] states in its paragraphs 3.5.1 and 4.2.1 that the frequency band 876-880 MHz UL / 921-925 MHz DL is the only one to be part of the railway interoperability requirements. Furthermore, in

paragraphs 3.5.4 and 4.2.1ii, the frequency band 873-876 MHz UL / 918-921 MHz DL, i.e. the ER-GSM band, may be used for applications that are not related to railway interoperability.

As per the Commission Regulation 2016/919 [50], EIRENE FRS v8.0.0 requires in its paragraph 4.1.3iii that the cab-radio⁴ shall be able to operate in the ER-GSM frequency band (this requirement is optional to EDOR⁵ or handheld terminals). Hence the implementation of the GSM-R extension band in the 3GPP specifications, in harmonised standards and EIRENE FRS shows that this is an issue of general importance and not limited to national regulations. RFID and SRD signals in 918-921 MHz will be seen as in-band signals by the new GSM-R cab-radios. This can be considered as a potential issue (due to the listening everywhere in the “extended band”). This situation should however not impact the RFID/SRD harmonisation considerations.

In some countries already today the traffic demand from railway communication via GSM-R cannot be fully provided especially in big stations, traffic nodes, wide railway shunting areas and national borders due to lack of frequencies. To support the idea of a single European Railway Network additional requirements according to EU legislation have to be fulfilled. As part of a Trans-European Railway Network, ETCS, the European Train Control System will increase the traffic load onto GSM-R further. This can only be provided with the use of the ER-GSM frequencies for national application.

It should be noted that a consistently high quality of voice communications (i.e. low interference and high speech quality) is needed for emergency calls, shunting communication and other mission-critical railway radiocommunications. This is particularly important in the case of group calls where multiple users are involved across a number of different GSM-R radio cells.

ANNEX 4: provides exemplary national information from Germany giving a more comprehensive view.

ANNEX 6: includes considerations on intermodulation product interference into GSM-R from NBN SRD network access points/ base stations and RFID installations in the vicinity of rail tracks.

2.6.3 FRMCS (Future Railway Mobile Communication Systems) – GSM-R follow-on options for considerations

The term FRMCS is used in this section to name a project launched by the International Railway Union (UIC) to define the successor system to GSM-R; in the context of this document, it designates the system itself.

To date, the technology for the successor system for GSM-R has not been chosen. In the light of the implementation timeframe, it is expected that FRMCS will use 3GPP 4G/5G radio access technology. It is unknown yet which channelisation will be available with 5G radio access; thus the mix of GSM-R and FRMCS in the same band is likely to vary from the current 1.4 MHz LTE channel and the compression effort on GSM-R may be different.

Given the context concerning SRD/RFID, railway radiocommunications and related recent development, it may be advantageous to consider in the long term to have a European regulation where spectrum identified for railway is in the frequency ranges 875-880 MHz and 920-925 MHz (2 x 5 MHz), with the optional national use of MFCN spectrum as a complement. This has still to be investigated in the CEPT/ECC after arrival of the ETSI SRdoc TR 103 333 [13]; hence, the considerations at this stage are only preliminary ones. According to these preliminary considerations in the System Reference Document, railways could need up to 2 x 7 MHz of spectrum to accommodate current and future railway mission-critical applications and usages for the coming decades, taking into account the need for parallel operation of GSM-R and FRMCS during the migration from GSM-R to the successor system.

As a consequence of this, it is considered that the frequency ranges 875.1-876 MHz and 920.1-921 MHz (2 x 0.9 MHz) should not be recommended for European harmonisation for SRD/RFID in a mandatory manner at this stage to keep this option open (only 900 kHz instead of 1 MHz to preserve the opportunity for the highest RFID interrogator channel at 919.9 MHz centre frequency).

⁴ On-board voice terminal

⁵ On-board data only terminal

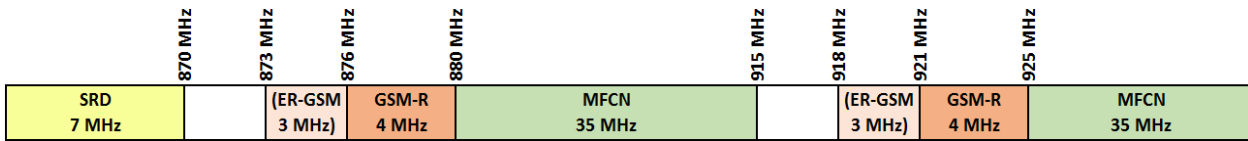


Figure 4: Spectrum environment with GSM-R and ER-GSM indicated

Note that there is also some military usage in the bands 870-876 MHz and 915-921 MHz (see section 2.6.1).

The migration from GSM-R to FRMCS may need to run both systems in parallel for a period of no less than 10 years.

Early considerations were triggered by the ERA (European Union Railway Agency) in two studies which are available:

1. Considerations in the ERA coexistence study [52] show that only under a set of limiting conditions it may be possible to operate a GSM-R network plus a 1.4 MHz LTE carrier within the current GSM-R band of 2 x 4 MHz.
2. Studies have shown that the current GSM-R band of 2 x 4 MHz is not enough for such a migration where both systems will be operating simultaneously. 5 MHz could potentially be possible with some restrictions (ERA migration study [51]).

2 x 5 MHz (rough order of magnitude) identified for railway will increase the chances to manage the migration using only identified railway spectrum. For countries not using the GSM-R extension spectrum, 2x2 MHz remains available for SRD/RFID.

Another alternative possibility for countries that cannot manage GSM-R migration within 2x5 MHz may be to, under a limited time period, use part of the commercial 900 MHz band. In that case, this would need to be handled in a future licensing renewal for the 900 MHz band.

For countries which see a long term bandwidth requirement for railway that exceeds 2x5 MHz, the lower part of the commercial 900 MHz MFCN (880-915 MHz and 925-960 MHz) band could also be an option and be nationally assigned for FRMCS.

When discussing sharing between railways and commercial operators, a considerable number issues will need to be duly assessed (e.g. cost for the infrastructure manager, network control, maintenance, railway certification aspects, contractual commitments, technology aspects, frequency sharing aspects) and this has not been studied yet and is not part of this Report.

For countries which want to apply some early considerations at the current stage, considering future railway mobile communication system use, it is recommended to consider SRD/RFID implementations in the frequency range between 870.0 MHz and 875.1 MHz as well as 915.8-920.1 MHz. In addition, it should be noted that, for data networks, wideband data transmission systems and RFID installations in these bands, registration/notification or individual authorisation can also be used to ensure protection of radio services operating in the band as well as in the adjacent bands. Countries can take this into account with regard to the current usage, the migration period and the long term regulation.

2.6.4 PMR USAGE

ECC Report 25 [18] assumed in 2003 that the use of spectrum for PMR/PAMR in the 870-876/915-921 MHz band could relieve the more congested 400 MHz bands. This has however not materialised. In addition, PMR specifications such as TETRA 900 were withdrawn later on. The probability of the real implementation of PMR/PAMR in 870-876/915-921 MHz is very low in Europe despite of having the band included in ECC/DEC/(04)06 [6] and reflection in the ECA Table (ERC Report 25) over nearly two decades. Several countries reported that PMR/PAMR has been allocations in their countries but that network operation either

has been terminated, or the network rollout being very limited, or network not fully put into operation, or either is simply unused (no licences awarded). The PMR/PAMR usage is recorded only in parts of the band (Georgia only 870-876 MHz, Poland 870-874.44 MHz, Spain: 4 local licences).

In 2016, the bands 870-876MHz and 915-921 MHz were removed from the PMR/PAMR band plan set out in CEPT Recommendation T/R 25-08 [22].

3 CONSIDERATION OF POSSIBILITIES IN SPECIFIC SHARING SITUATION

3.1 GEOGRAPHICAL SHARING TO AVOID INTERFERENCE INTO THE MOBILE SERVICE

Geographical sharing, based on location, can be facilitated by administration, e.g. by defining those areas where alternative use is allowed (see the indicative regional use for ER-GSM in Germany in ANNEX 4:) or by limiting Defence applications to designated military areas. This also requires that the alternative use can be restricted to certain geographical areas. This is normally difficult for license-exempt usage on a domestic basis. It could be difficult to provide the information to the market about which specific regions are authorised and which are not. Mitigation techniques could also be considered. However, these must fit to the applications in mind and their related considerations and should only be applied appropriately.

Considerations on geographical sharing with military applications (and perhaps also some other governmental applications) is addressed in section 3.2 below.

Geographical sharing with ER-GSM is addressed in section 3.3 below.

It is proposed to include the option of geographical sharing with GSM-R, in the possibilities for national implementation since it can provide a means for some administrations to enable the implementation of RFID and networked SRD over a considerable part of their territory. Geographical separation can also be a possibility to be investigated on national level with governmental services.

This takes into account the governmental use in some countries. It is emphasised that low power SRD applications (up to 25 mW, DC of up to 0.1%) are recommended to be considered on a national basis also for sharing with some defence applications (e.g. TRR based on FH as well as fixed frequency use, narrowband military PMR applications), if so agreed on a national basis, even if the spectrum is currently identified on an exclusive basis for defence applications.

It was concluded in ECC Report 200 [9] that:

For countries that in the time of peace restrict the use of TRR (Tactical Radio Relay links) to designated military exercise areas, adequate physical separation between SRDs/RFIDs and TRR must be ensured. Under these conditions sharing with SRDs/RFIDs may be feasible and further aided by requiring SRDs to use APC.

3.2 SHARING BETWEEN SRDS/RFIDS AND TRR, UGV, AND UAS

ECC Report 200 concluded that sharing between RFIDs (band 915-921 MHz) and TRR and sharing between RFIDs (band 915-921 MHz) and UAS (Unmanned Aircraft Systems) will not be feasible.

However, any possible future harmonisation measure needs to resolve:

- If RFIDs were allowed in some countries but not in other countries (because of TRR), which challenges would such a way forward cause for the enforcement and market surveillance tasks on national level?

Vast majority of RFID use is in installations.

- How could a European wide binding regulation for SRDs/RFIDs provide flexibility regarding the different available amount of spectrum in different Member States?

It was concluded in ECC Report 200 that:

For countries that in time of peace allow the use of TRR anywhere across their territory, especially in urban areas, sharing between SRDs (band 870-876 MHz) and TRR may be feasible subject to specific conditions. In particular, these conditions must impose limitations on SRDs covering emitted power, DC and the density of SRDs per square km, as indicated in the studies. Irrespective, there will be some residual level of interference and the overall noise level to TRR will be increased.

Consideration(s):

- How could different conditions (power limitations, DC, density per km²), depending on the national situation, be reflected in a European wide binding regulation for SRDs?
- Which challenges would such a way forward cause for the enforcement and market surveillance tasks on national level?

E.g. by applying appropriate administrative measures (for example individual licensing) to ensure that a density limit would not be exceeded.

For countries that allow use of UAS anywhere across their territory, especially in urban areas, co-frequency sharing between SRDs (870-876 MHz) and UAS may be feasible subject to specific conditions. In particular, these conditions impose limitations on the emitted power of SRDs, their DC and the density of SRDs per square km, as indicated in the studies. Irrespective, there will be some residual level of interference and the overall noise level to UAS will be increased.

Consideration(s):

- How could different conditions (power limitations, DC, density per km²), depending on the national situation, be reflected in a European wide binding regulation for SRDs?
- Which challenges would such a way forward cause for the enforcement and market surveillance tasks on national level?

E.g. by applying appropriate administrative measures (for example individual licensing) to ensure that a density limit would not be exceeded.

- How could UGV's (Unmanned Ground Vehicle) and other military applications be protected, which are used e.g. in Germany in the ranges 870-873 MHz and 915-918 MHz?

This takes into account the governmental use in some countries. It is emphasised that low power SRD applications (up to 25 mW) are recommended to be considered on a national basis also for sharing with some defence applications (e.g. TRR based on FH as well as fixed frequency use, narrowband military PMR applications), if so agreed on a national basis, even if the spectrum is currently identified on an exclusive basis for defence applications. TRR also used in 863-870 MHz in a considerable number of countries.

The range 790-960 MHz was identified for military applications (according to the NATO Joint civil/military Frequency Agreement (NJFA) 2002, revised in 2014/15 [21])⁶. Because of the CEPT-wide deployment of MFCN and SRDs and – in some countries – also GSM-R in this range, the remaining part for military applications which is usable for critical military applications has been shortened to 870-876 MHz and 915-921 MHz (or only parts of it on national level). Especially for military unmanned systems the spectrum cannot be shared with SRDs or MFCN. Sharing between some military radio applications and GSM-R in the bands 873-876 MHz and 918-921 MHz is possible to some extent and may be applied at a national level.

In a number of CEPT countries (e.g. Germany, France) the bands 870-873 MHz and 915-918 MHz are designated exclusively for military radio applications and therefore it cannot be expected that they can be made available e.g. for short range device applications for the present. In addition, the bands 873-876 MHz

⁶ See document FM38(05)Info02

and 918-921 MHz are designated for military radio applications in some countries and therefore it cannot be expected that they can be made available e.g. for short range device applications for the present.

3.3 SHARING WITH ER-GSM

So far, only one network operator in Germany has provided information about ER-GSM network implementation, and with a procurement process in progress for ER-GSM enabled equipment, in some geographical areas in Germany for the purpose of national operational railway applications. All other ER-GSM plans are at much earlier planning stage and regulators have neither issued a licence nor any plans known for real investment into ER-GSM operational networks. Switzerland has informed that a licence will be awarded in autumn 2016 according to the four country agreement Germany, Liechtenstein, Austria and Switzerland from 2012, and based on ECC/DEC/(04)06 [6].

ER-GSM is likely to be used at local hotspots such as some metropolitan stations or big shunting sites only. This was confirmed by Germany (advanced planning stage), Austria (early considerations), Belgium (early considerations, additional demand for GSM-R frequencies at the harbour of Antwerpen), and Hungary (border to Ukraine). Studies on intra-system compatibility impact of ER-GSM on E-GSM900, UMTS900 and LTE900 have been finally agreed in 3GPP. Without coordination between MFCN and GSM-R operators power reductions for ER-GSM base station emissions would be needed. However, coordination between both sides should anyway be achieved to ensure coexistence between both sides.

A possible solution, by taking into account the protection requirements for the ER-GSM service, could be based on geographical sharing to make national implementations for networked SRD (fixed installations) as well as RFID fixed installations possible. This solution requires the national regulatory authority to make the information about ER-GSM protection areas available in the public as well as defining a notification/registration duty or individual authorisation for those to indicate the location of the SRD/RFID installation. This will also help to follow the market take-up (demand) for SRD and RFID new innovative applications. Note that a considerable part of the new market demand is for M2M/IoT applications based on networked SRD and RFID technical solutions which are fixed installed networks.

In addition, GSM-R is not using all the channels at a given location. Network planning normally avoids using adjacent channels. This may also provide the possibility to use the remaining 'ER-GSM usage gaps' for other usage. This would normally require cooperation information from the primary user in a national coordination approach. In the future, it could also be possible to mandate SRD/RFID users to register to a geo-location database so as to check available frequencies (also because the frequency use in GSM-R networks is not static). However, such an alternative was so far not investigated nor is it subject to standardisation activities yet.

This geographical sharing option would also make the RFID DAA mitigation technique for the protection of ER-GSM redundant. The RFID community indicated to have evaluated the market opportunity for UHF RFID with DAA to be marginal. However, alternatively, the use of mitigation technologies (reduced duty cycled SRDs and UHF RFID with DAA, should also be provided as a national implementation option. The DAA mechanism is specified to demodulate GSM-R BCCH channels and hence, false triggering occurrence is unlikely compared to mitigation techniques which only sense power in the spectrum. In this regard, ETSI TS 101 602 includes 'Technical Specification on Preliminary Tests and Trial to verify mitigation techniques used by RFID systems for sharing spectrum between RFID and ER-GSM', published in July 2013, describes the test plan and the results of a series of tests and measurements that were performed to verify the effectiveness of cognitive mitigation techniques applied to UHF RFID systems sharing the band 918 MHz to 921 MHz with GSM-R.

The LDC mitigation possibilities for SRDs as well as the DAA mitigation technique for RFID have been studied and set out in ECC Report 200 [9]. They are shown in the Table 2: below.

At the same time, ER-GSM is not implemented in the vast majority of CEPT countries and these countries could make use of the technical conditions set out in ERC/REC 70-03 [5] without using these mitigation techniques. Note that some countries have already implemented SRD/RFID regulations in accordance with ERC/REC 70-03 with ER-GSM protection requirements in order to keep this sharing possibility, if they were to deploy ER-GSM.

Table 2: Technical conditions for accessing spectrum with and without sharing with ER-GSM

Application	Frequency bands	Access spectrum w/o restriction where spectrum is not shared with ER-GSM	Access spectrum where spectrum is shared with ER-GSM
Generic SRDs	873-876MHz / 918-921MHz	25mW / DC 1%	25mW / DC : 0.01% Max transmit on time : 5ms/s
MRAN	873-875.6 MHz	500mW / DC 2.5%	500mW / DC 0.01% Max transmit on time : 5ms/s
NRP	873-875.6 MHz	500mW / DC 10% Individually licence may be needed (NRP density up to 10 NRP per km2 possible according to ECC Report 200 [9] – otherwise NRPs start to interfere/impact to each other)	Individually licence Coordination required
RFID	918-921 MHz	4 W (interrogators)	DAA

Hence, those administrations which do not have or foresee a sharing situation between SRDs/UHF RFIDs and ER-GSM are proposed to implement the SRD/UHF RFID opportunities without the more restrictive parameters (provided there are no other limitations provided by the protection requirements of other radio services).

EN 302 208 [34] for UHF RFID as well as the ETSI Technical Specifications ETSI TS 102 902 V1.2.2 [35] and ETSI TS 102 903 V1.1.1 [36] have the DAA mitigation technique included and are available.

It should be noted in this context that the CEPT has received from ETSI information about activities for the design of LDC in ETSI Special Task Force STF411. As can be seen in the following table, there are actually a lot of SRD applications which could make use of quite restrictive LDC parameters.

Application	Latency	Max Cumulated TxON time	TxON time /s	Average	TxOFF	Cumulated TxON per day	Max equivalent DC	Comment	Number of devices	Urban density
	in sec	over 1 second [in seconds]	%	activity	in s	in seconds	with current definition		Estimated in Europe	Estimated
telecomand										
	100ms	1	100.00%	1400	0.1	1400	1.620%			
Metering		25ms to 1s								
without in home display	8s	0.025	2.50%	1	0.1	0.025	0.000029%		Millions	
with in home display	1s	0.025	2.50%	96	0.1	2.4	0.003%		Hundred thousands	
Repeaters	100ms	0.025	2.50%	50	0.01	1.25	0.001%		Millions	
EN13753 Mode R2	15min	1	100.00%	20	0.1	20	0.023%			
Alarms		25ms to 1s								
Intrusion alarm	3s	0.025	2.50%	24	0.1	0.6	0.001%		Millions	
Social alarm	2s	0.15	15.00%	4	0.1	0.6	0.001%		Millions	
Battery power devices	1 min	1	100.00%	24	0.1	24	0.028%		Millions	
Imaging	3s	1	100.00%	6	0.1	6	0.007%	3 mins of transmission once a month	New request from customers	
Referee voice system		0.1	10.00%	3600	0.9	360	0.417%			

All the aforementioned described implementation options should be available for national implementations. This would reflect the different national situations with regard to the ER-GSM usage and at the same time maximise the degree of harmonisation and implementation that can be achieved in Europe at the current time. New innovative wideband SRD applications with access points should therefore be considered also relevant with LDC mitigation for the protection of ER-GSM. This should be kept as an option for wideband SRDs and related access points/terminal points. It seems not to be an option which is attractive for NBN SRD networks.

3.4 DEPLOYMENT DENSITY CHANGES – POSSIBILITIES FOR REVIEW

Even if compatibility studies demonstrate that low power and high power radio services and applications can coexist, under certain conditions, in a same frequency band and in the adjacent bands, this may create a future challenging situation in the case of, for example, SRDs are deployed with densities higher than expected. This could also lead to significant problems with radio services in the band and in the adjacent bands, which shall not be interfered. In addition, ECC Report 200 [9] also showed that only a limited number of data networks can use the same spectrum.

The United Kingdom has included in their implementation for the bands 870-876 MHz / 915-921 MHz a possibility for a review in the future with regard to MRANs for data acquisition purposes.

4 OTHER OPTIONS AND CONSIDERATIONS

4.1 DEFINE A SECTION LEFT FREE OF LICENSE-EXEMPT DEVICES

The option to define in each of the bands 870-876 MHz and 915-921 MHz a section which should be left free of license-exempt devices has been discussed.

Advantages:

- Demand for future 'GSM-R follow-on' systems is unknown yet. It is impossible to reform a harmonised license-exempt band in the future. See section 2.6.3.

Disadvantages:

- A considerable number of countries have the opportunity to implement applications under general authorisation within the whole bands 870-876 MHz and 915-921 MHz;
- There is currently no radio service usage in CEPT countries for which a European harmonisation activity could be envisaged;
- Even the set out of military primary usage or civilian usage in the NTFAs and utilisation plans does not necessarily mean that the spectrum is de-facto used (example: PMR usage is reflected in many NTFAs but does hardly exist in the bands 870-876 MHz / 915-921 MHz).
- Digital cellular services or similar are difficult to operate above 915 MHz due to the mobile service UE OOB emissions, making a secondary usage almost only available option for use in in 915-918 MHz (and if paired, also 870-873 MHz). This is however not valid for the frequency range 873-876 MHz and 918-921 MHz.

4.2 RELATED MARKET SURVEILLANCE AND MARKET ENFORCEMENT CONSIDERATIONS

A harmonisation approach must also take into account the free circulation in the European internal market, related enforcement considerations and the protection needs of radio services such as ER-GSM, governmental services, and services in adjacent bands. Especially for higher power applications in the non-specific, broad application field, and RFID which does not restrict to specific application fields, when operated in the vicinity of radio services to be protected, and especially when having the potential to be operated outside of fixed installations or SRD networks. Hence:

- mobile and nomadic RFID interrogators could be excluded from the harmonisation measure in light of the flexible harmonisation approach due to the specific protection needs to ER-GSM in some countries as well as possible other issues with some governmental/military applications;
- non-specific SRDs which support mobile or nomadic use could be excluded from the harmonisation approach for the same reasons.

This should also be specified in the applicable harmonised European standards, and scope of their application.

This should not be seen as another usage restriction but rather a means how to maximise the degree of harmonisation and implementation that can be achieved in Europe at the current time, and responding to a large part of the stipulated demand.

Many emerging M2M/IoT applications are very dominantly or exclusively fixed installed applications such as UHF RFID, metering, home automation etc. The concept of class 1 equipment is not needed to be applied for these applications. National implementation information should be visible somewhere and can be facilitated via EFIS.

The proposal for harmonisation is to include all the above mentioned options which are currently available and with the restrictions indicated. The approach has to provide a 'toolbox' for national implementations with

the necessary degree of flexibility with regard to the precise implementation in a respective country. The proposal in ANNEX 3: therefore describes all these implementation possibilities which are optional.

4.3 NATIONAL RESTRICTIONS FOR SRDS ON EMITTED POWER AND DC AS WELL AS OTHER MITIGATIONS

National restrictions with regard to emission reductions or country-specific duty cycle restrictions should be avoided since this would fragment the European market. Maximising the degree of harmonisation is the target. This will have a positive effect on cost of equipment and economy of scale and make some new innovative applications possible.

4.4 INDIVIDUAL AUTHORISATIONS

This is discussed in the following chapter 5. The Authorisation directive art. 5.1, if justified to achieve QoS or avoidance of interference, also ECC Report 132 [38] provides this possibility and some CEPT administrations have actually issued or plan to issue individual licenses and using the technical conditions in ERC/REC 70-03 [5]. Such licenses can operate on a shared basis according to the results of ECC Report 200. Individual licenses providing exclusive access to spectrum are not proposed in this Report and can lead to monopolisation of a part of the spectrum (and related application provision) below 1 GHz for certain IoT/M2M applications using networks. This is a significant difference to networks which provide so-called 'mission-critical' services such as in the PPDR, PMR, transportation or smart grids field (latter on e.g. high voltage network switches with very short latency requirements) which often will require exclusive access to related spectrum.

5 REGULATORY ASPECTS

Article 3 of Commission Implementing Decision (2006/771/EC [2], amended by 2013/752/EU [3]) on harmonisation of the radio spectrum for use by short-range devices requires that “Member States shall designate and make available, on a non-exclusive, non-interference and non-protected basis, the frequency bands for the categories of short-range devices”. Article 2 of this Decision defines that “ ‘non-interference and non-protected basis’ means that no harmful interference may be caused to any radio communications service and that no claim may be made for protection of these devices against harmful interference originating from radio communications services.”

In addition, it is highlighted in recital-3 of EC Decision 2006/771/EC that “radiocommunications services, as defined in the International Telecommunications Union Radio Regulations, have priority over short-range devices and are not required to ensure protection of particular types of short-range devices against interference.”

The allocation to the mobile service, except aeronautical mobile service, in some CEPT administrations (e.g. in Germany) which provides the regulatory conditions for ER-GSM and for military radio applications, is in line with Article 5 of the ITU Radio Regulations.

By taking into account these legal requirements it is obvious that any spectrum designation for SRDs/RFIDs in the ranges 870-876 MHz and 915-921 MHz would be based on the conditions for the protection of the radio service.

Besides the national needs also cross-border usage need to be taken into account because of the free circulation and use, typically applied for SRD equipment.

The EC Decision for SRD explains in (3) that *as this type of device uses radio spectrum with low emission power and short-range emission capability, its potential to cause interference to other spectrum users is typically limited. Therefore such devices can share frequency bands with other services which are, or are not, subject to authorisation, without causing harmful interference, and can co-exist with other short-range devices. Their use should therefore not be subject to individual authorisation pursuant to the Authorisation Directive 2002/20/EC.*

The word ‘should’ as shown above normally carries the meaning of a recommendation but not the meaning of a mandatory aspect. In addition, the authorisation aspect is a matter on national level of the Member States.

This is the only text position in the EC Decision for SRDs where the authorisation method is mentioned. Apart from this, Article 2 explains that SRDs operate on a non-protected basis.

Article 5.1 of the Authorisation Directive stipulates that *“Member States shall, where possible, in particular where the risk of harmful interference is negligible, not make the use of radio frequencies subject to the grant of individual rights of use but shall include the conditions for usage of such radio frequencies in the general authorisation”.*

Frequency opportunities for infrastructure network systems should be included in the European Common Allocation Table by inclusion of ECC harmonisation measure (e.g. ERC/REC 70-03 [5]), the NTFAs of the individual administrations and also being registered at the BR IFIC, if operation takes place at locations close to international borders.

Metropolitan Mesh Machine Networking (M3N) as well as other SRD networks will enable the sharing of several services on a single network, allowing interaction between devices of different services. M3N will allow various devices to be connected to different city automation & monitoring services over a single network - a first step toward the Internet of Things. When comparing the emerging Automotive, SM/SG and M3N requirements it becomes clear that the study in ECC Report 200 needed to determine acceptable DC limits at different power levels up to 500 mW.

It may be additionally noted that the nature of smart metering and smart grid applications may call for establishing a certain network infrastructure, i.e. a small number of access gateways to sink data collected from across various terminal nodes into fixed infrastructure maintained by e.g. a utility company. Due to acting as traffic aggregators, the activity on these nodes will be higher than on the terminal nodes. The industry therefore requested to define a separate SRD device type that may be referred to as “Network Relay Point (NRP)” and described as follows:

“Devices deployed by organisations, such as utilities or other infrastructure operators, to support wider operations, and thereby restricted in their deployment by nature. Such devices will not be operated by the general public/consumers.”

This is another type of professionally deployed networks with wider coverage; therefore it may be anticipated that NRPs (Network Relay Points) also will be used in M3N network applications.

This report therefore considers the possibilities regarding the authorisation scheme for the introduction of NRPs which have a significant impact on co-existence prospects of proposed SRD applications, i.e. there is a need for coordination. It should be noted that such devices will, typically, receive similar levels of aggregated traffic from a large number of serviced nodes.

The key requirements for such new networks can be described as follows:

1. It is in the public interest that such infrastructure networks operate under sufficient operational conditions providing an acceptable quality of service, firstly for the provision of such services and secondly meeting the expectations from the public;
2. Infrastructure networks can serve totally different purposes in several market sectors and there is not necessarily a coordination procedure in place amongst operators of infrastructure networks of different market sectors;
3. The introduction of such infrastructure networks should not be limited a priori in terms of the number of networks, the application field or the market sector;
4. The frequency regulation should be technology-neutral and specific network topologies cannot be foreseen for the future;
5. Fragmentation of spectrum use should be avoided as much as possible;
6. Existing SRD categories as set out in CEPT Report 44 [30] should be used.

ECC Report 132 [38] includes reference terminologies as shown in the table below in order to capture some fundamental differences between various regulatory options. This categorisation should also be used for defining the authorisation regime for infrastructure networks.

Individual authorisation (Individual rights of use)		General authorisation (No individual rights of use)	
Individual licence (1)	Light-licensing		Licence-exempt (4)
	(2)	(3)	
Individual frequency planning / coordination. Traditional procedure for issuing licences	Individual frequency planning / coordination. Simplified procedure compared to traditional procedure for issuing licences. With limitations in the number of users	No individual frequency planning / coordination. Registration and/or notification. No limitations in the number of users nor need for coordination	No individual frequency planning / coordination. No registration nor notification

Within the EU there is a harmonised regulatory framework for rights of use in the context of Electronic Communications Networks and Services (ECN&S). The relevant texts are the “Framework” Directive and the “Authorisation” Directive. The two Directives allow two kinds of authorisation status in relation to right of use

of frequencies for ECN&S: general authorisations or individual rights of use (article 5 §1 of “Authorisation” Directive and article 9 §1 of the “Framework” Directive). Infrastructure Communication Systems clearly fall into this framework for the delivery of electronic Communications Networks and Services.

General authorisations

The “Authorisation” Directive sets the legal provisions for general authorisations. General authorisations allow any undertaking to provide electronic communications networks or services, whether by means of radio frequency spectrum or by wired means. Undertakings may be required to submit a notification but cannot be required to obtain an explicit decision before exercising the rights stemming from the general authorisation. For notification, Member States shall not request more information than a declaration by a legal or natural person of the intention to commence the provision of ECN&S and minimal information needed to keep a list of providers of ECN&S (identification of provider, address, short description of the network or services, starting date/putting into operation for activity).

In the case of radio spectrum use, general authorisations are in practice normally limited to radio services that do not need to be coordinated to avoid harmful interference. The consideration in this case of infrastructure networks is however limited to intra-infrastructure network coordination and not coordination on international level or with regard to radio services in the operation spectrum or adjacent to it. General authorisation as opposed to individual rights of use cannot be transferred as, by definition, the spectrum can be accessed without the need to obtain an individual authorisation and therefore there is no exclusive right to be traded.

The harmonised implementation by national administrations is here critical to support effective enforcement policy. Key principles were provided in CEPT Reports 14 and 44 to support a strategy to improve the effectiveness and flexibility of spectrum availability for Short Range Devices (SRDs). It is questionable whether the availability of compatibility studies for such infrastructure network systems alone gives sufficient protection (e.g. limitation of the number of NRPs in the studies performed under ECC Report 200) and there is also the need to ensure compatibility between systems now and in the future) and there is no effective enforcement policy defined for this case.

Infrastructure network providers are expected to provide a minimum QoS, in particular when it comes to coverage. They like to have full control over the interference they face, and therefore have full understanding of the performance that will be delivered by their network equipment. Operators also need to have full visibility over their future access to spectrum in order to be in a position to develop investment plans. A pure concept of first come first served is not compatible with the delivery of services based on coverage characteristics. On the other side, exclusive spectrum usage for such networks is not needed and may lead to inefficient spectrum usage at a given place, at a given time, for a predictable future. This requirement was also not raised by ETSI when delivering proposals in several ETSI system reference documents to the ECC.

Individual rights of use

Taking into account the scarcity of radio frequencies in some frequency bands as well as the need to ensure efficient use of these frequencies individual rights of use /individual authorisations may be granted as opposed to general authorisations. Individual rights of use are often, depending on the context, called “licences” and both expressions can be used. For ECN&S, individual rights of use may be granted for four reasons, in order to:

- Avoid harmful interference;
- Ensure technical quality of service;
- Safeguard efficient use of spectrum;
- Fulfil other objectives of general interest as defined by administrations States in conformity with e.g. EU Community law.

The “Authorisation” Directive defines a set of conditions that may be attached to individual rights of use (Annex B of the Directive).

Individual rights of use, which in many administrations take the form of licences granted to users, may be transferred as prescribed by Article 9b of the "Framework" Directive. The European Commission may adopt appropriate implementing measures to identify ECN&S bands for which individual rights to use radio frequencies may be transferred or leased (except for frequencies used for broadcasting). In other bands the choice is left to Member States to make provisions for undertakings to transfer or lease individual rights of use. When granting rights of use the Member States shall specify whether those rights can be transferred by the holder of the licence and under which conditions (in accordance with Article 9b).

The individual authorisation approach may also need to be accompanied by an operator selection and authorisation process which is difficult in this case of infrastructure networks, if not impossible, since the future need for infrastructure networks, from different market sectors, cannot be sufficiently defined at the present time.

From the considerations above, it seems that option 3 (light licensing under general authorisation) is the preferable option for infrastructure network points (NRPs) since in line with the considerations above since:

- there is no intention to limit the number of users or the number of infrastructure network opportunities;
- there is a minimum technical need to coordinate the NRPs;
- limitation of the burden is needed for NRAs, no individual frequency planning is suggested. Instead, NRAs can set up a registration/notification procedure and define clear spectrum sharing rules under which the providers of infrastructure networks can get engaged in a suitable coordination procedure amongst themselves without the need to engage the NRA. The responsibility of the NRA is to set up the rules in a non-recurrent way for such a procedure when implementing the spectrum regulation.

Option is in general under the general authorisation regime, i.e. all applicants in the field of operating infrastructure networks can use the general authorisation and it is not intended to approve such network operation on an individual basis or to limit the number of users. There are neither individual rights nor individual obligations in connection to this general authorisation. The ruling applies to all operators in the same way.

The coordination need is proposed to be solved by a registration / notification process which is also established to provide a meaningful basis for an enforcement strategy in cases of collisions and used for the avoidance of conflicts. This is considered to be in the public interest and the NRA would keep the information and may act in conflict situation if considered necessary.

Since the approach is based on exemption from individual licensing, it is more flexible with regard to adapting the procedure to future requirements as opposed to individual authorisations which normally fix the precise usage conditions over the duration of the license.

The coordination procedure should be based on fair principles and earlier notifications should not block later ones to avoid situations where individual infrastructure network operators can claim seniority just by filing as many networks as possible with as wide as possible coverage service areas. Therefore, the approach could be based on the coordination obligation with regard to existing NRPs which have already put into operation and not on "paper networks".

Some CEPT administrations are already using individual licences or registration/notification duties for some applications in the 870-876 MHz and 915-921 MHz, or are planning to do so:

- United Kingdom: For MRANs, this is under general authorisations with a notification duty and possibility of a review after 5 years;
- Sweden: Awarded four nationwide licences in the frequency range 870-876 MHz with the technical conditions as set out in ERC/REC 70-03 [5] for 'SRD networks'. These four licence holders share the spectrum in 870-876 MHz;
- There are 4 local licences in Spain, broadband digital technology for applications as M2M, meter reading and data;
- Austria: 873-876 MHz planned for GSM-R, however only at certain locations. Individual licensing foreseen for M2M/IoT networks with technical conditions from ERC/REC 70-03.

As outlined earlier, geographical sharing solutions for implementations for M2M/IoT applications based on networked SRD and RFID technical solutions, which are fixed installed networks, in the bands 870-876 MHz and 915-921 MHz may need a form of registration/notification duty to be acceptable from the perspective of market enforcement so as to ensure protection of the radio services. A suitable solution for this could be that the administration publishes the information about the geographical area to be protected and the user/operator of networked SRD and RFID solutions would need to notify the location of their installation.

Conclusion: general authorisations are the preferred solution for the harmonisation in 870-876 MHz and 915-921 MHz but the harmonisation approach should also include the freedom for national administrations to either include registration/notification duties as part of a general authorisation or to allow individual authorisations for networked SRDs/M2M/IoT networks and RFID installations where needed in order to ensure that the risk of harmful interference is negligible. It should be made clear to applicants that registration/notification or individual authorisation do not provide them with protection. Exclusive access to spectrum by licensed applications is to be avoided, i.e. shared use should be possible up to a certain extent ('do not monopolise part of the spectrum to only one SRDs/M2M/IoT network').

National administrations may issue SRD new network licences/ require the licensees to:

- keep records of where they deploy higher duty cycle NRPs;

and

- ensure that higher duty cycle NRPs use effective politeness protocols.

EXAMPLE FOR INFORMATION TO BE PROVIDED BY DATA NETWORK OPERATORS

ECC Report 200 describes the use of network access points/network relay points forming part of metropolitan area networks such as for utilities or other applications for the purpose of data acquisition.

Network relay points can be operated by various providers in the same metropolitan area and are recommended to be notified to the administration as part of a general authorisation framework. This means that it is not intended to limit the number of data networks in a given area a-priori and that the principles as set out in CEPT Report 44 [30] should apply such as equal access to the spectrum, on a shared basis, in a technical and application neutral manner. Further technical measures are not recommended at the moment but may be subject to review, should traffic overload situations materialise in the future. The regulatory approach set out in this Recommendation should be reviewed in future, in case the actual deployment and attributes of such networks fall outside of that assumed in both ECC Report 200 [9].

Such a network operates typically in mesh configuration. Within the mesh it is essential to have Network Access Points/Relay Points (NRP) to push/pull data into the network at appropriate locations or complete the mesh, where necessary. The number and location of NRP is very much dependent on the flow of data through the network. ECC Report 200, in note 4 states; "Installation only by professionals – e.g. operator of Smart Metering/M3N network".

This Report defines NRP as follows:

Device deployed by organisations, such as smart utilities, municipal, industrial, transport, logistics or other metropolitan/rural area network operators, to support wider area operations. NRPs provide connectivity for one or more otherwise isolated network devices by forwarding traffic in both directions between the network and the isolated device(s). Such devices will be limited in their deployment and will not be operated by the general public/consumers.

It is recommended to notify the operation of such NRP to the national regulatory authority. Such a notification should include as a minimum, the indicative information in Table 1. Alternatively, an administration would not require such data but imposes a review after 5 years (e.g. United Kingdom).

Table 4: Example for Information to be provided by Data Network Operators in the frequency range 870-875.6 MHz, 870.0-875.6 MHz, four channels centred at 916.3 MHz, 917.5 MHz, 918.7 MHz and 919.9 MHz (Indicative list)

Information	To be filled in
Network operator name	..
Network operator address	..
Network control facility designated point of contact <ul style="list-style-type: none"> - Contact name - Contact telephone number - Contact email address 	..
Number and location (coordinates or address) of Network Relay Points	..
Metropolitan/Rural Area Network Coverage (define area, e.g. map, coordinates of the extension of the coverage area)	..
Date of putting into operation Purpose of the network Node height Indoors or outdoors? Node deployment comments Maximum power Modulation scheme DC limit (if less than 10%) Daily traffic profile (day vs. night) ER-GSM adaption capability	..

The idea is that such information could lead to a list of operators or service providers who are operating in same geographical area and frequencies. The actual network structure and elements locations are made available by each operator on need basis. Operators are not bound to inform network structure in advance, but are requested to explain their network operation and structure when needed.

ETSI has created the new harmonised European standard EN 303 204 [32] for network based SRDs in support of clear definitions and sound regulatory framework for such networks to ensure that polite spectrum access mechanisms are employed to avoid spectrum overload situations. The scope and general requirements of the standard shall ensure that networked SRD effectively coordinate between differing networks to ensure the effective operation of all compliant networks.

The same concept can be used for RFID installations in the band 915-921 MHz.

6 IDENTIFIED FOR FUTURE INVESTIGATIONS

This addendum to CEPT Report 59 [1] does not include all opportunities studied in the ECC Report 189 [8] and ECC Report 200 [9], ECC Report 246 [11] and ECC Report 261 [10]. Further investigations may be conducted during the next following update under the permanent mandate for updates of the technical annex of the EC Decision for SRD.

The permanent mandate does also provide the possibility to react to new developments on the market which could potentially lead to a review of existing regulatory approaches. This is in particular valid for new innovative application where the technology can still change. An example is the UHF RFID technology which was changed twice in the last 15 years (from a time division approach to reader channels and tag responses in adjacent spectrum, and further into a 4-channel plan). The precise maximum emission levels and number of channels (channel plan) and related channel bandwidth could be subject to future review consideration. This should however not impact current considerations on harmonisation.

Changes in the spectrum environment for the bands 870-876 MHz and 915-921 MHz, in particular uncertainty regarding the take-up of ER-GSM in the market (so far, only Germany has confirmed investment plans in an ER-GSM network) and the long-term planning towards FRMCS are future challenges which cannot be fully foreseen, neither at present nor in the near future. The process towards FRMCS (including sharing or hybrid solutions with MFCN) will take considerable investigations and time. Note in this regard also AI 1.11 at WRC-19. While this report attempts to take this into account and some flexibility is provided, future reviews may be necessary. However, this should not stop current considerations and harmonisation efforts.

A number of outstanding issues are proposed to be discussed in the 7th update process for the EC Decision for SRDs:

- Harmonisation possibilities for the band 862-863 MHz;
- Safe harbour band for applications such as alarms, social alarms and similar applications requiring a reliable spectrum access that is not shared with higher duty cycle SRD: this was considered based on existing opportunities in ERC/REC 70-03 [5], and also for the band 862-863 MHz. This needs further consideration, e.g. inter-alia with regard to the amount of spectrum to be proposed for harmonisation and LTE UE OOB already present in that band;
- Further considerations for additional opportunities for data networks in the frequency ranges 862-863 MHz, 865-868 MHz, and 915-921 MHz (the potential use of NBN SRD in the first RFID interrogator channel requires additional study);
- Concerning the Adaptive Power Control (APC) mechanism for SRD in data networks, future investigations may identify other mitigation techniques to provide alternatives in support of innovative networks and related technical aspects.

7 CONCLUSIONS

CEPT administrations have to protect existing radiocommunications service use (i.e. mainly national military and governmental use, national ER-GSM use) in the considered bands and the options for implementation in this Report must take this into account. Any future EU harmonisation measure has to ensure that neither an implementation on national level has to be mandatory what could affect that national sovereignty, nor must such a harmonisation measure lead to a situation that the free circulation and use of equipment in Europe might cause negative effects on these existing usages in the relevant countries.

Proposals

The proposals set out in ANNEX 3: gather the following changes:

- new opportunities for wideband data transmission devices in data networks in the bands 863-868 MHz and 915.8-920.8 MHz; in the band 915.8-920.8 MHz the frequency range 918-920.8 MHz is preferred; Member States may alternatively implement at least 2.8 MHz within the whole frequency range 915.8-920.8 MHz depending on national circumstances, e.g. by considering the future railway mobile communication system;
- new opportunities for SRD in data networks in the band 870-875.6 MHz as well as within the four interrogator RFID channels in the bands 865-868 MHz and the upper three RFID interrogator channels in 915-921 MHz (two 200 kHz channels for SRD in data networks in each of the three available RFID interrogator channels in 915-921 MHz); in the band 870-875.6 MHz the frequency range 874-875.6 MHz is preferred; Member States may alternatively implement at least 1.6 MHz within the whole frequency range 870.0-875.6 MHz depending on national circumstances, e.g. by considering the future railway mobile communication system;
- new opportunities for RFID interrogator channels in the band 915-921 MHz (four 400 kHz channels);
- new opportunity for 25 mW non-specific SRD in data networks in the band 915.8-920.8 MHz; the frequency range 918-920.8 MHz is preferred; Member States may alternatively implement at least 2.8 MHz within the whole frequency range 915.8-920.8 MHz depending on national circumstances, e.g. by considering the future railway mobile communication system.

They are presented in the table format of the technical annex of the EC Decision for SRD, with an additional column with considerations to make it easier to understand. These proposals complement the harmonised frequency bands in the range 863-870 MHz already defined in the EC Decision [3].

SRD in data networks and wideband data transmission systems in data networks within the proposed bands in 863-868 MHz and 915-921 MHz should comply with Mask Option 1 (-54 dBm/100kHz in the spurious domain, see Annex 1 of ECC Report 246 and ECC Report 261 [10] respectively).

This new SRD regulatory framework within 915-921 MHz brings the clear benefit to achieve a not only European harmonisation but also a wider harmonisation with many countries outside of Europe. The 902-928 MHz band was originally for ITU-R Region 2; however, it does get widely copied around the world, in particular in Australia and New Zealand. It is also becoming widespread across Asia, in particular for RFID, such as in Singapore, Vietnam, Malaysia and Japan. There are also aspects of it in South Africa, and other countries, mixing European and American regulations.

The demand for automotive applications and audio applications for the bands 870-876 MHz and 915-921 MHz has not been confirmed.

Need for flexibility:

The general approach for these new opportunities in the bands 870-876 MHz and 915-921 MHz is to give administrations some flexibility with regard to the precise implementations. This is necessary in order to ensure protection of the radio services:

- In countries where parts or all of these frequency ranges are used by military applications and coordination is not possible, Member States may decide not to implement the relevant entry partially or in its entirety in accordance with Article 1(4) of Decision 676/2002/EC [4];

- The requirement of the protection of ER-GSM implies that the respective entry cannot be made available without additional restrictions, e.g. geographical restriction, reduced duty cycle, etc.;
- National rules may be needed to ensure local coordination in order to avoid interference to radio services operating in the band as well as in adjacent bands, e.g. due to intermodulation or blocking;
- For entries for wideband data transmission devices and data networks within the bands 870-876 MHz and 915-921 MHz, some preferred frequency ranges are indicated but it is also proposed to indicate wider frequency ranges within which alternative implementation may be possible, depending on national circumstances.

A general authorisation regime is the preferred solution for the harmonisation in 870-876 MHz and 915-921 MHz. However, the harmonisation approach should also include the freedom for national administrations to either include registration/notification duties as part of a general authorisation or to implement a registration/notification or an individual authorisation regime for SRD in data networks and RFID installations where needed in order to ensure that the risk of harmful interference is negligible. It should be made clear to applicants that registration/notification or individual authorisation do not provide them with protection. Exclusive access to spectrum by licensed applications is to be avoided, i.e. shared use should be possible up to a certain extent ('do not monopolise part of the spectrum to only one SRD/M2M/IoT network'), i.e. the use of spectrum should be made available on a non-exclusive, non-interference and no-protection basis.

In addition, the proposals made in Annex 3 are considered to be as technology-neutral as possible, enabling future innovation and flexibility with regard to how services can be offered.

As a consequence of the flexible approach, SRD and RFID equipment operating in frequency ranges 870-876 MHz or 915-921 MHz **cannot** fall under the radio equipment class 1 category according to the definitions in the Radio Equipment Directive: 'Class 1: radio equipment that can be operated without any restriction in EU, EEA and EFTA'.

The new entries are dominantly for new types of M2M/IoT applications in SRD networks, proposed to either fall into the wideband transmission system category, RFID or in the non-specific SRD category (latter one with the other usage restriction that the technical conditions apply only for data networks). These applications are typically bound to fixed locations as the typical common usage scenario. The proposal for using the non-specific category (instead of proposing a new category 'data networks' for the EC Decision) is made based on the perspective that such data acquisition networks can serve a very broad range of purposes, e.g. for utilities, tourist information, in the transportation sector, anything else in 'smart cities' etc, and the category should be open to future innovation.

Noting that there is free circulation of radio equipment within the EU internal market under the Radio Equipment Directive, it is only possible to make a harmonisation proposal for 25mW non-specific SRDs in the range 915.8-920.8 MHz under the indicated conditions in ANNEX 3:. Individual administrations may be in a position to adopt less restrictive conditions or wider frequency ranges as indicated in ERC/REC 70-03 [5] Annex 1 band h3) on a national basis.

Harmonisation proposals for non-specific SRD use were discussed, but were felt to contradict the obligations of the regulatory authorities to ensure protection of radio services (in this case mainly military use and ER-GSM).

The flexible implementation concept provides new opportunities for new innovative applications and attempts to activate the spectrum opportunities where possible, e.g. by using possibilities provided by geographical sharing.

The proposal in this report is not a complete approach but considers what seems possible at this time and for items for which a consensus could be achieved. Chapter 6 identifies items for further investigations.

For countries considering the future railway mobile communication system, this report makes a recommendation to avoid at this stage SRD/RFID implementations in the upper 2x900 kHz, i.e. in 875.1-876 MHz and 920.1-921 MHz, since this is an option to enable the future migration from GSM-R. However, it is noted that it will take time in the future until all aspects will be investigated within CEPT and elsewhere.

In addition, it should be noted that all new proposed entries in ANNEX 3: refer to the harmonised standards (or equivalent specifications), with standardisation activities on-going in ETSI. This shows the importance of the standardisation work in this regard, also to ensure that all requirements set out in the regulatory approach are accomplished, and this will also help to protect radio services in the bands 870-876 MHz and 915-921 MHz and adjacent bands.

It is proposed to include geographical restrictions in the possibilities for national implementation since it can provide a means for some administrations to fulfil the minimum amount of spectrum to be implemented over a considerable part of their territory. Geographical separation can also be a possibility to be investigated on national level with governmental services.

ANNEX 1: EXISTING NATIONAL IMPLEMENTATION AND EXAMPLES

The latest updated existing national implementation information is available in the EFIS database: http://www.efis.dk/sitecontent.jsp?sitecontent=srd_regulations

Table 5: ERC/REC 70-03 Annex 1 [5]

Frequency Band	Power / Magnetic Field	Spectrum access and mitigation requirements	Modulation/ maximum occupied bandwidth	ECC/ERC deliverable	Notes
h2 870-876 MHz	25 mW e.r.p.	≤ 0.1% duty cycle For ER-GSM protection (873-876 MHz, where applicable), the duty cycle is limited to ≤ 0.01% and limited to a maximum transmit on-time of 5ms/1s	≤ 200 kHz		This frequency band is also identified in Annexes 2 and 5
h2.1 870.000-875.800 MHz	25 mW e.r.p.	≤ 1% duty cycle For ER-GSM protection (873-875.8 MHz, where applicable), the duty cycle is limited to ≤ 0.01% and limited to a maximum transmit on time of 5ms/1s	≤ 600 kHz		The frequency band is also identified in Annexes 2 and 5
h3 915-921 MHz	25 mW e.r.p.	≤ 0.1% duty cycle For ER-GSM protection (918-921 MHz, where applicable), the duty cycle is limited to ≤ 0.01% and limited to a maximum transmit on-time of 5ms/1s	≤ 200 kHz		The frequency band is also identified in Annexes 10 and 11
h3.1 915.200-920.800 MHz	25 mW e.r.p. except for the 4 channels identified in note 9 where 100 mW e.r.p. applies	≤ 1% duty cycle (note 10) For ER-GSM protection (918-920.8 MHz, where applicable), the duty cycle is limited to ≤ 0.01% and limited to a maximum transmit on-time of 5ms/1s	≤ 600 kHz except for the 4 channels identified in note 9 where ≤ 400 kHz applies		The frequency band is also identified in Annexes 10 and 11

Note 9: The available channel centre frequencies are 916.3 MHz, 917.5 MHz, 918.7 MHz and 919.9 MHz. The channel bandwidth is 400 kHz.

Note 10: RFID tag emissions responding to RFID interrogators operating on centre frequencies 916.3 MHz, 917.5 MHz, 918.7 MHz and 919.9 MHz are not duty cycle limited.

Harmonised Standard: EN 300 220 [31]

Use of all or part of sub-bands may be denied in some European countries that use all or part of these sub-bands for defence/governmental systems. In other countries that use sub-bands 873-876 MHz/918-921 MHz for GSM for railways, extended band (ER-GSM), access to the part 873-876 MHz/918-921 MHz by non-specific SRD applications require implementing additional mitigation measures such as transmission timing limitations as set out in ECC Report 200 [9].

The adjacent frequency bands below 915 MHz and above 876 MHz as well as 921 MHz may be used by high power systems. Manufacturers should take this into account in the design of equipment and choice of power levels.

Table 6: Existing Implementation

Frequency band	Country	Remark
h2	Albania, Denmark, Estonia, Hungary, Iceland, Ireland, Liechtenstein, Luxembourg, Moldova, Norway, Slovenia, Switzerland, United Kingdom. Under study or planned: Austria, Croatia, Finland, Russian Federation	Finland limited to 870-873 MHz. United Kingdom and Hungary: Additional restrictions to protect ER-GSM apply. Liechtenstein and Switzerland limited to 870-873 MHz: ER-GSM protection. Slovenia: limited to 873-876 MHz. Austria: 873-876 MHz planned for GSM-R, however only at certain locations.
h2.1	Albania, Denmark, Estonia, Hungary, Iceland, Ireland, Liechtenstein, Luxembourg, Moldova, Norway, Slovenia, Switzerland, United Kingdom. Under study or planned: Austria, Croatia, Finland, Russian Federation	Finland limited to 870-873 MHz. United Kingdom and Hungary: Additional restrictions to protect ER-GSM apply. Liechtenstein and Switzerland limited to 870-873 MHz: ER-GSM protection. Slovenia: Limited to 873-875.8 MHz. Austria: 873-876 MHz planned for GSM-R, however only at certain locations.
	Albania, Denmark, Estonia, Hungary, Ireland, Liechtenstein, Luxembourg, Moldova, Norway, Slovenia, Switzerland, United Kingdom. Under study or planned: Austria, Croatia, France, Iceland, Russian Federation	United Kingdom and Hungary: Additional restrictions to protect ER-GSM apply. Liechtenstein and Switzerland limited to 915-918 MHz: ER-GSM protection. Slovenia: Limited to 918-921 MHz. Austria: 918-921 MHz planned for GSM-R, however only at certain locations. France: non-specific SRDs in 918-921 MHz (incl. wideband SRDs) on technology neutral basis under study. Iceland: 915-921 MHz - some spread spectrum fixed links in use mostly in the middle of the country (highlands) by the Icelandic Met Office.
h3.1	Albania, Denmark, Estonia, Hungary, Ireland, Liechtenstein,	United Kingdom and Hungary: Additional restrictions to protect ER-GSM apply.

Frequency band	Country	Remark
	<p>Luxembourg, Moldova, Norway, Slovenia, Switzerland, United Kingdom.</p> <p>Under study or planned: Austria, Croatia, France, Iceland: Russian Federation</p>	<p>Liechtenstein and Switzerland limited to 915-918 MHz: ER-GSM protection.</p> <p>Slovenia: Limited to 918-920.8 MHz.</p> <p>Austria: 918-921 MHz planned for GSM-R, however only at certain locations.</p> <p>France: non-specific SRDs in 918-921 MHz (incl. wideband SRDs) on technology neutral basis under study.</p> <p>Iceland: 915-921 MHz - some spread spectrum fixed links in use mostly in the middle of the country (highlands) by the Icelandic Met Office.</p>

ANNEX 1: NON-SPECIFIC SHORT RANGE DEVICES

870 - 876 MHz

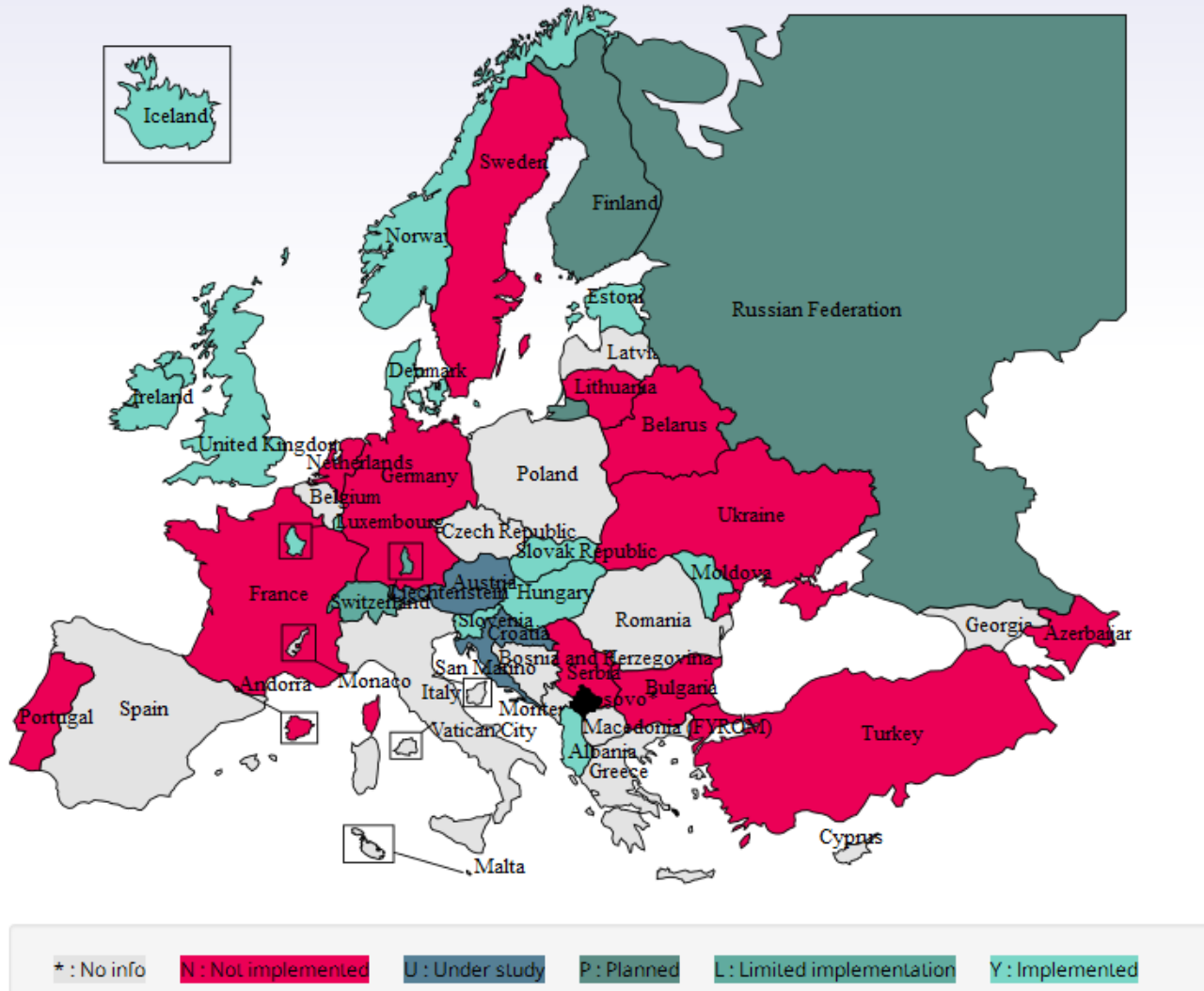


Figure 5: Existing implementation ERC/REC 70-03 Annex 1 in 870-876 MHz

ANNEX 1: NON-SPECIFIC SHORT RANGE DEVICES

915 - 921 MHz

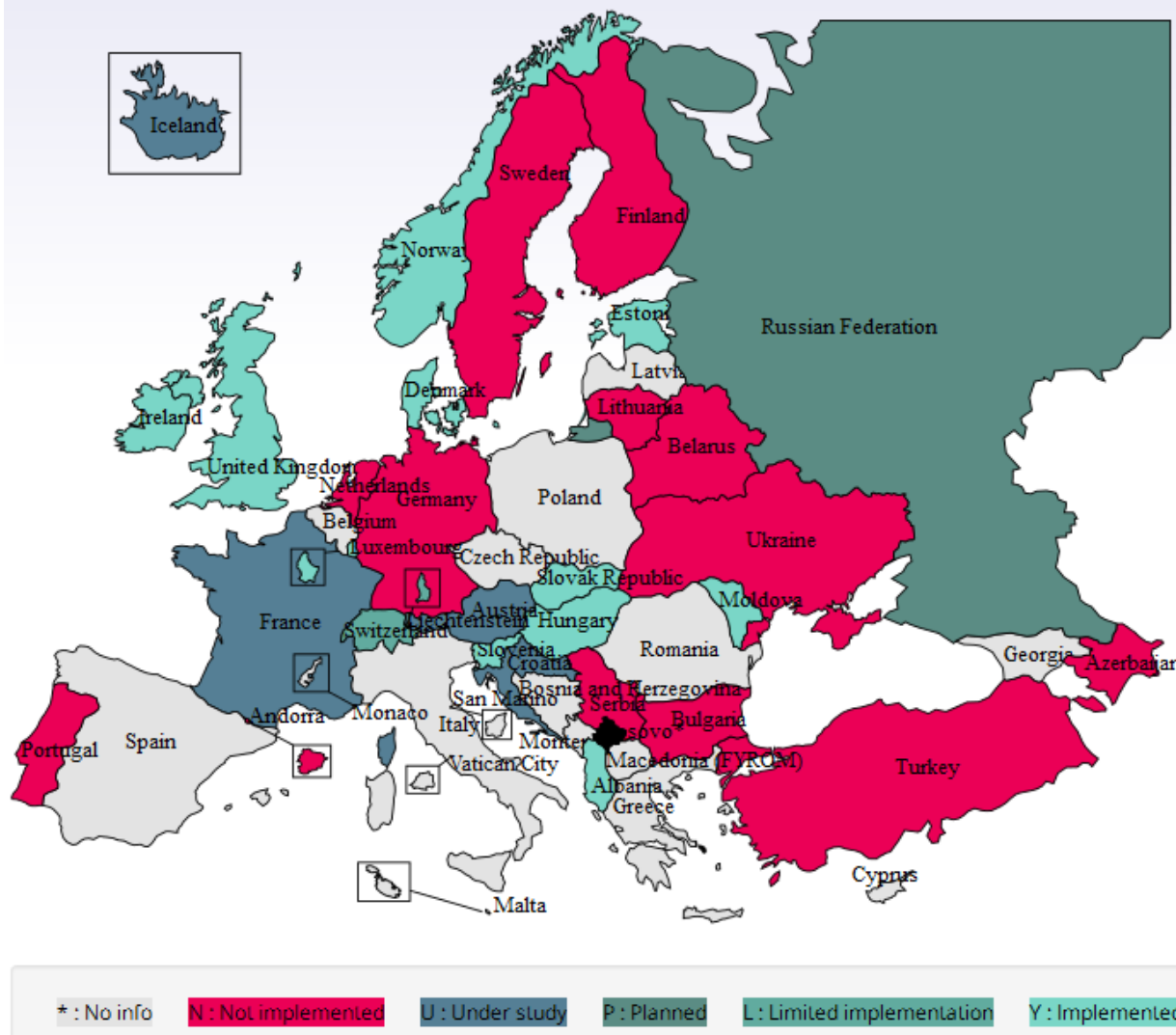


Table 7: Existing implementation ERC/REC 70-03 Annex 1 in 915-921 MHz

Table 8: ERC/REC 70-03 Annex 2 [5]

Frequency Band	Power / Magnetic Field	Spectrum access and mitigation requirements	Modulation/ maximum occupied bandwidth	ECC/ERC Decision	Notes
c 870.000-875.600 MHz	500 mW e.r.p.	≤ 2.5% duty cycle and APC required (note 1). For ER-GSM protection (873-875.6 MHz, where applicable), the duty cycle is	≤ 200 kHz		Individual license may be required for Metropolitan / Rural Area Networks. Adaptive Power Control (APC) required. The APC

Frequency Band	Power / Magnetic Field	Spectrum access and mitigation requirements	Modulation/ maximum occupied bandwidth	ECC/ERC Decision	Notes
		limited to $\leq 0.01\%$ and limited to a maximum transmit on time of 5ms/1s (note 2)			Control is able to reduce a link's transmit power from its maximum to ≤ 5 mW. The frequency band is also identified in Annexes 1 and 5

Note 1: a duty cycle of up to 10% may be allowed for network relay points forming part of metropolitan/rural area networks such as for utilities or other applications for the purpose of data acquisition. Network relay points should be individually licensed. National regulatory authorities may consider the provision of general authorisations (options as defined in ECC Report 132 [38]) for network relay points forming part of metropolitan/rural area networks which have implemented additional Listen-Before-Talk (LBT) and frequency/channel agility/adaptivity mitigation techniques and/or coordination in geographic areas of a high number of network relay points.

Note 2: except if a procedure with the railway operator is employed (e.g. coordination or cognitive techniques) in order to avoid interference into occupied ER-GSM channels.

Harmonised Standard: EN 303 204 [32]

Use of all or part of sub-band d may be denied in some European countries that use all or part of these sub-bands for defence/governmental systems. In other countries that use sub-band 873-876 MHz for GSM for railways, extended band (ER-GSM), access to the part 873-876 MHz by non-specific SRD applications require implementing additional mitigation measures such as transmission timing limitations as set out in ECC Report 200 [9].

Table 9: Existing Implementation

Frequency band	Country	Remark
h2	Albania, Denmark, Estonia, Finland, Hungary, Ireland, Iceland, Luxembourg, Moldova, Norway, Slovenia, Sweden, United Kingdom. Under study or planned: Austria, Croatia, France, Liechtenstein, Russian Federation, Switzerland	Finland limited to 870-873 MHz. Hungary: Additional restrictions to protect ER-GSM apply. United Kingdom: For MRANs, this is under light licensing approach with a notification duty and possibility of a review after 5 years. This also includes the possibility of limiting the number of networks sharing the same frequencies. For the 873-876 MHz/ 918-921 MHz, the existing implementation keeps the option to have ER-GSM, i.e. SRD use limited to LDC and RFID with DAA mitigation, though this is now under review. Liechtenstein and Switzerland limited to 870-873 MHz: ER-GSM protection. France: possibilities for implementations in the 874-876 MHz for higher power SRDs with 500 mW e.r.p. and MRANs (incl. other technologies). Sweden: Awarded four nationwide licences in the frequency range 870-876 MHz with the

Frequency band	Country	Remark
		<p>technical conditions as set out in ERC/REC 70-03 for 'SRD networks'. These four licence holders share the spectrum in 870.876 MHz.</p> <p>Slovenia: limited to 873-875.6 MHz</p> <p>Austria: 873-876 MHz planned for GSM-R, however only at certain locations. Individual licensing foreseen for M2M/IoT networks with technical conditions from ERC/REC 70-03.</p>

ANNEX 2: TRACKING, TRACING AND DATA ACQUISITION

870 - 875.6 MHz

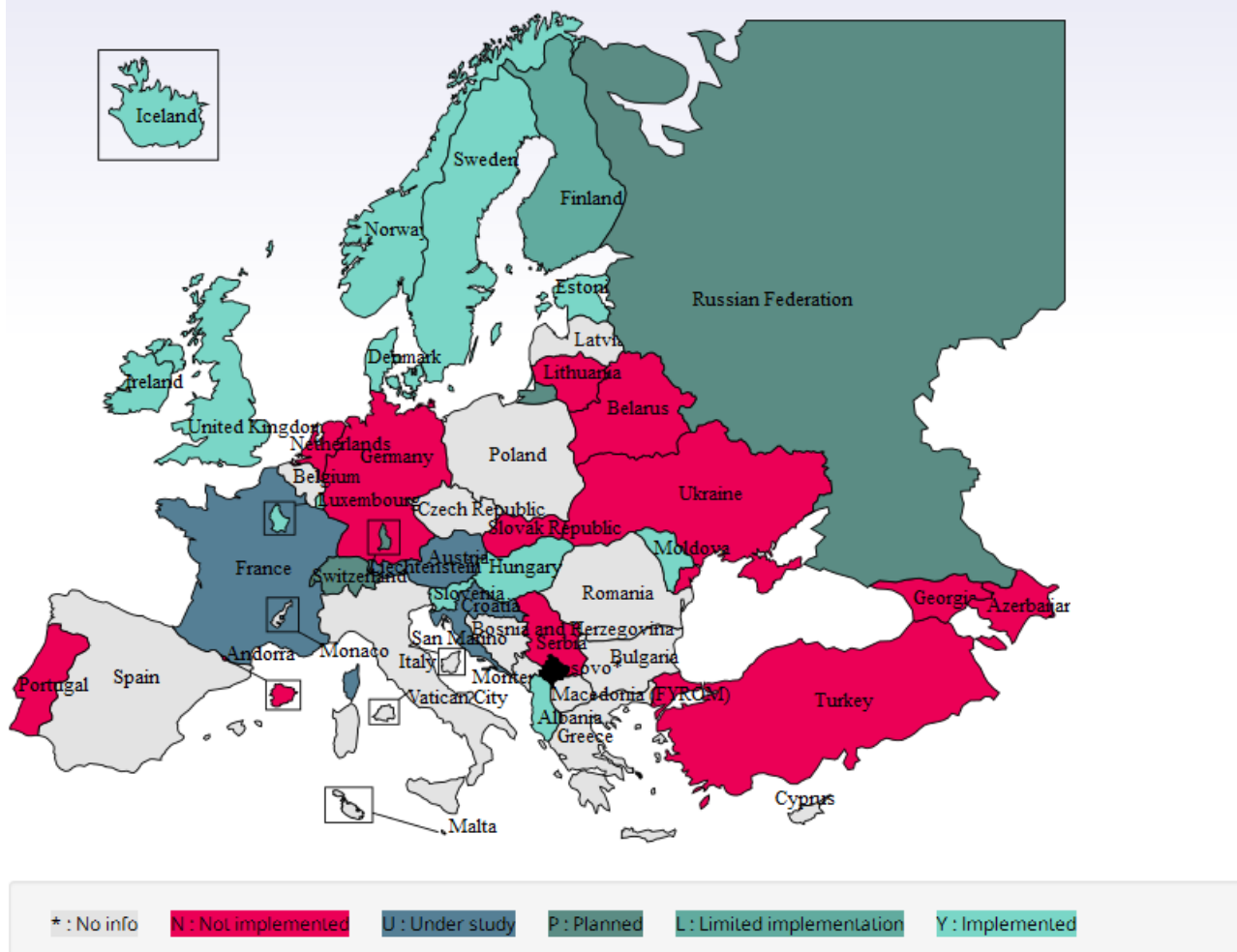


Figure 6: Existing implementation ERC/REC 70-03 Annex 2 in 870-875.6 MHz

Table 10: ERC/REC 70-03 Annex 5

Frequency Band	Power / Magnetic Field	Spectrum access and mitigation requirements	Modulation/ maximum occupied bandwidth	ECC/ERC deliverable	Notes
a 870.000-875.800 MHz	500 mW e.r.p. 100 mW e.r.p.	≤ 0.1% duty cycle For ER-GSM protection (873-875.8MHz, where applicable), the duty cycle is limited to ≤ 0.01% and limited to a maximum transmit on-time of 5ms/1s	≤ 500 kHz		500 mW restricted to vehicle-to-vehicle applications. 100 mW is restricted to in-vehicle applications. Adaptive Power Control (APC) is required. The APC is able to reduce a link's transmit power from its maximum to ≤ 5 mW. The frequency band is also identified in Annexes 1 and 2

Harmonised standard: EN 300 220 [31]

Use may be denied in some European countries that use all or part of this band for defence/governmental systems. In other countries that use sub-band 873-876 MHz for GSM for railways, extended band (ER-GSM), access to the part 873-876 MHz by automotive SRD applications requires implementing additional mitigation measures such as transmission timing limitations as set out in ECC Report 200 [9].

Table 11: Existing implementations

Frequency band	Country	Remark
a	Albania, Bosnia Herzegovina, Denmark, Estonia, Finland, Hungary, Ireland, Iceland, Liechtenstein, Luxembourg, Moldova, Norway, Slovenia, Switzerland, United Kingdom. Under study or planned: Croatia, Russian Federation	Finland limited to 870-873 MHz. Hungary and United Kingdom: Additional restrictions to protect ER-GSM apply. Liechtenstein and Switzerland limited to 870-873 MHz: ER-GSM protection. Slovenia: limited to 873-875.6 MHz

ANNEX 5: TRANSPORT AND TRAFFIC TELEMATICS (TTT)

870 - 875.8 MHz

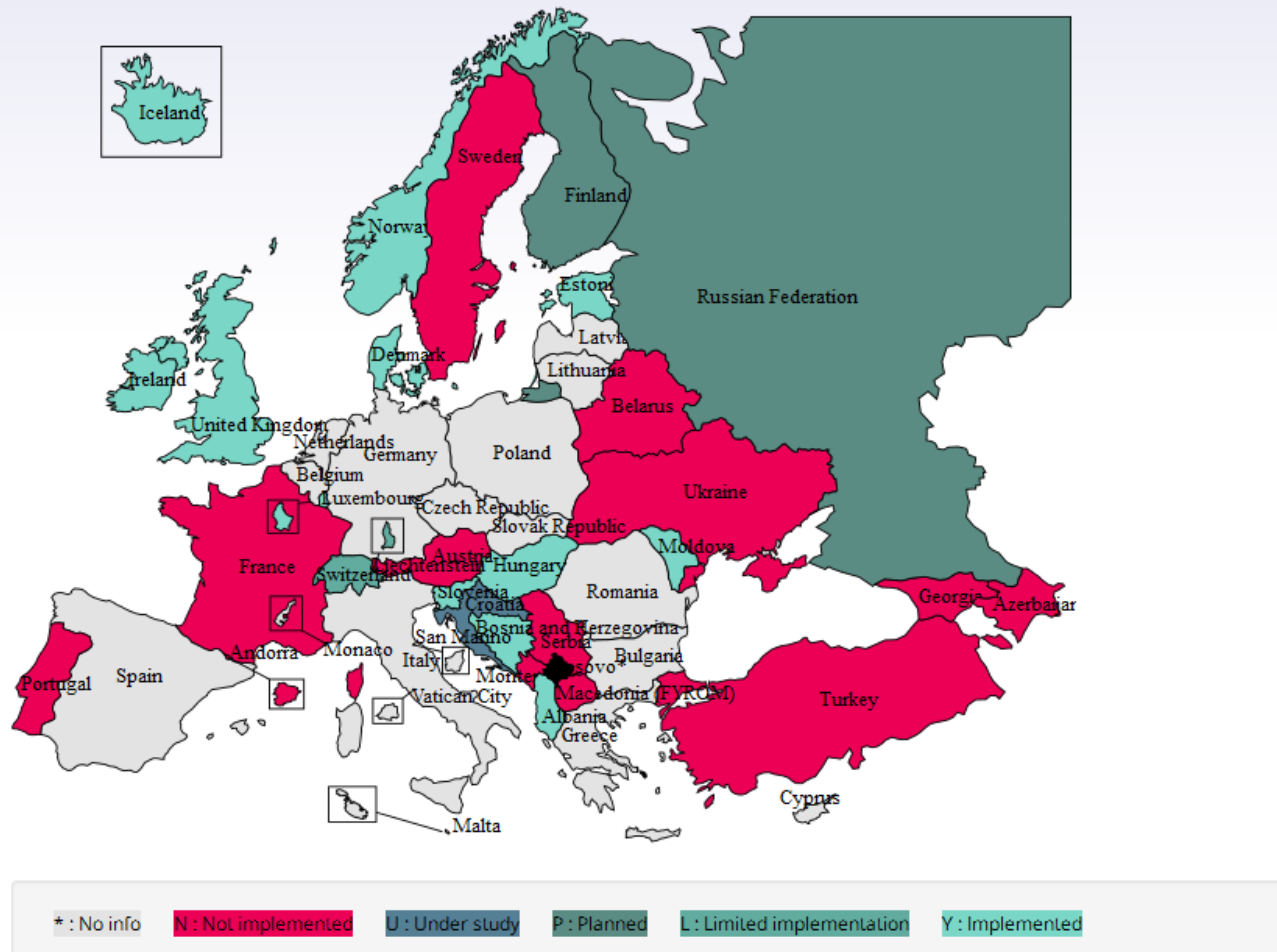


Figure 7: Existing implementation ERC/REC 70-03 Annex 5 in 870-875.8 MHz

Table 12: ERC/REC 70-03 Annex 10

Frequency Band	Power / Magnetic Field	Spectrum access and mitigation requirements	Modulation/ maximum occupied bandwidth	ECC/ERC Deliverable	Notes
h1 916.1-916.5 MHz	10 mW e.r.p.	≤ 25% duty cycle	≤ 400 kHz		Indoor Digital Assistive Listening Device (ALD) systems. The frequency band is also identified in annexes 1 and 11
h2 917.3-917.3 MHz	10 mW e.r.p.	≤ 25% duty cycle	≤ 400 kHz		Indoor Digital Assistive Listening Device (ALD) systems. The frequency band is also identified in annexes 1 and 11
h3 918.5-918.9 MHz	10 mW e.r.p.	≤ 25% duty cycle	≤ 400 kHz		Indoor Digital Assistive Listening Device (ALD) systems. The frequency band is also identified in annexes 1 and 11
h4 919.7-920.1 MHz	10 mW e.r.p.	≤ 25% duty cycle	≤ 400 kHz		Indoor Digital Assistive Listening Device (ALD) systems. The frequency band is also identified in annexes 1 and 11

Harmonised standard: EN 300 422 [33]

The available channel centre frequencies are 916.3 MHz, 917.5 MHz, 918.7 MHz and 919.9 MHz.

Use of all or part of these channels may be denied in some European countries that use all or part of these sub-bands for defence/governmental systems or, in some countries that use sub-band 918-921 MHz for GSM for railways, extended band (ER-GSM).

Table 13: Existing Implementations

Frequency band	Country	Remark
h1 to h4	Albania, Denmark, Estonia, Hungary, Ireland, Liechtenstein, Luxembourg, Moldova, Norway, Slovenia, Switzerland, United Kingdom. Under study or planned: Croatia, Iceland, Russian Federation	Hungary and United Kingdom: Additional restrictions to protect ER-GSM apply. Liechtenstein and Switzerland limited to 870-873 MHz: ER-GSM protection. Iceland: some spread spectrum fixed links in use mostly in the middle of the country (highlands) by the Icelandic Met Office

ANNEX 10: RADIO MICROPHONE APPLICATIONS INCLUDING ASSISTIVE LISTENING DEVICES (ALD), WIRELESS AUDIO AND MULTIMEDIA STREAMING SYSTEMS

916.1 - 916.5 MHz

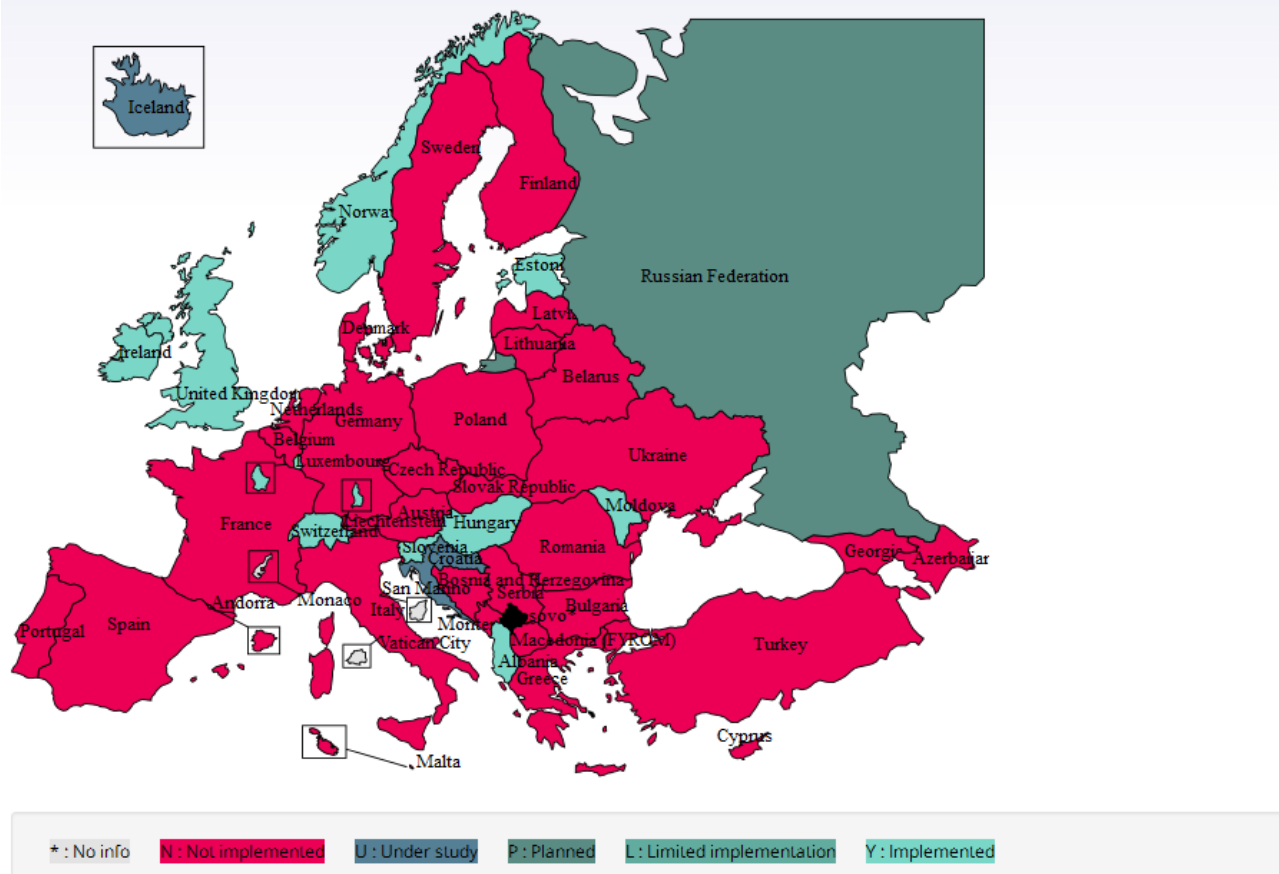


Figure 8: Existing implementation ERC/REC 70-03 Annex 10 in 916.1-916.5 MHz

Table 14: ERC/REC 70-03 Annex 11

Frequency Band	Power / Magnetic Field	Spectrum access and mitigation requirements	Modulation/ maximum occupied bandwidth	ECC/ERC deliverable	Notes
b 915-921 MHz	4 W e.r.p. (note 2)	For ER-GSM protection (918-921 MHz, where applicable), DAA is required	≤ 400 kHz		The frequency band is also identified in annexes 1 and 10. Operation only when necessary to perform the intended operation, i.e. when RFID tags are expected to be present

Note 2: Interrogator transmissions in band b at 4 W e.r.p. are only permitted within the four channels centred at 916.3 MHz, 917.5 MHz, 918.7 MHz and 919.9 MHz; each with a maximum bandwidth of 400 kHz.

Harmonised standard: EN 302 208 [34]

Use of all or part of sub-band may be denied in some European countries that use all or part of these sub-bands for defence/governmental systems. In other countries that use sub-band 918-921 MHz for GSM for railways, extended band (ER-GSM), and access to the part 918-921 MHz by UHF RFID applications requires implementation of additional mitigation measures such as Detect-And-Avoid (DAA) as set out in ECC Report 200 [9].

Table 15: Existing implementations

Frequency band	Country	Remark
b	Albania, Denmark, Estonia, Hungary, Ireland, Liechtenstein, Luxembourg, Moldova, Norway, Russian Federation, Slovenia, Switzerland, United Kingdom. Under study or planned: Austria, Croatia, France, Iceland, Ukraine	Hungary and United Kingdom: Additional restrictions to protect ER-GSM apply. Liechtenstein and Switzerland limited to 915-918 MHz: ER-GSM protection. Slovenia: limited to 918-921 MHz. France: UHF RFID without DAA under study. Austria: Austria: 918-921 MHz planned for GSM-R, however only at certain locations. Iceland: some spread spectrum fixed links in use mostly in the middle of the country (highlands) by the Icelandic Met Office.

ANNEX 11: RADIO FREQUENCY IDENTIFICATION APPLICATIONS

915 - 921 MHz

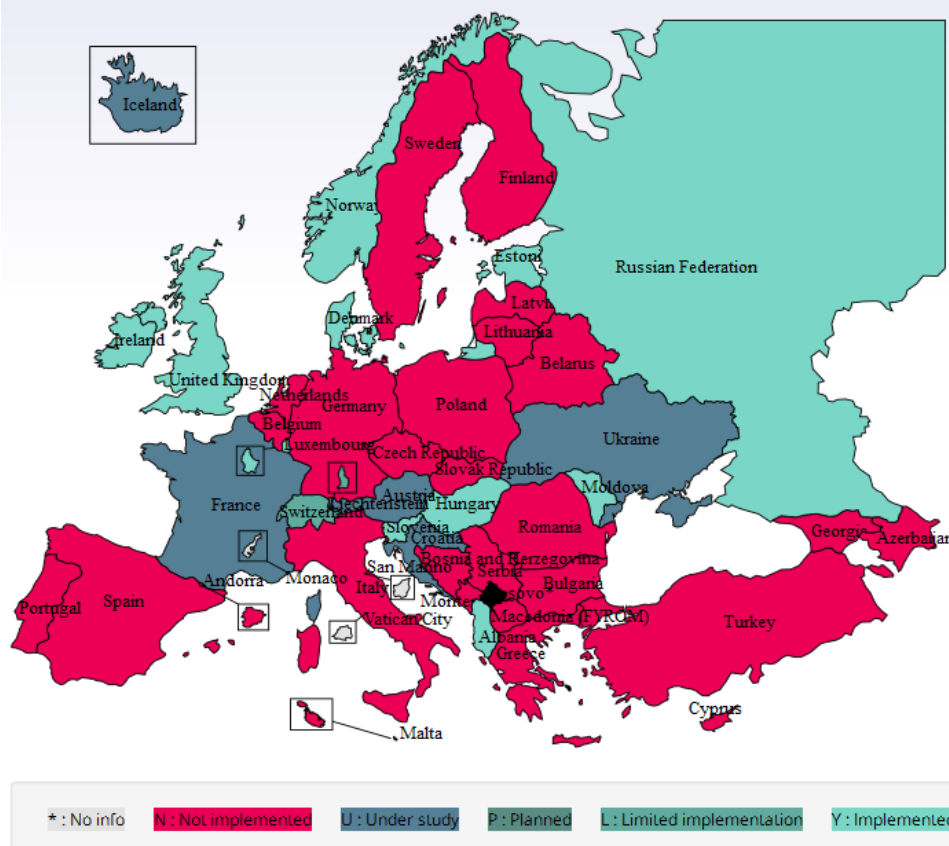


Figure 9: Existing implementation ERC/REC 70-03 Annex 11 - RFID in 915-921 MHz

Note: the status 'Not implemented' refers to the existing situation. This does not necessarily preclude opportunities for SRDs and RFIDs in the future for an individual country (see survey results from 2012 in ANNEX 3:).

Additional information/indication of countries with opportunity to implement SRD and RFID usage in the bands 870-876 MHz/ 915-921 MHz for which either 'no information' or 'No' is indicated according to the 2012 survey (and for which the situation is not explained earlier in this annex), see below:

Table 16: Existing Implementations

Frequency band	Country
Whole spectrum in 870-876 MHz and 915-921 MHz unused	Andorra, Belarus, Bosnia Herzegovina, Czech Republic, Latvia, Lithuania, FYROM, Malta, Montenegro, Turkey, Ukraine
Part of the spectrum with opportunity / unused	Poland 874.44-876 MHz and 915-921 MHz. Czech Republic: 870-872 MHz / 915-917 MHz: on their possible utilisation will be decided in accordance with the European harmonisation. The CDMA network in 872-876 MHz / 917-921 MHz was terminated in 2015. Similar situation in the Slovak Republic

National consultation processes:

To those administrations investigating national implementations based on the entries in ERC/REC 70.03 [5], it is suggested that administrations should conduct a national consultation on technical proposals that will subsequently enable the authorisation of license-exempt use of certain Short Range Devices (SRDs) in the frequency bands 870 to 876 MHz and 915 to 921 MHz. ERC/REC 70.03 can be taken as a basis for the technical proposal.

The outcome of such a national consultation process would help to identify the existing interests in using these frequency bands and could ultimately permit a more efficient use of the spectrum, in all or parts of the frequency bands 870 to 876 MHz and 915 to 921 MHz.

Such a national consultation can also assist introducing licensing for NRPs will assist the early development of the emerging Internet of Things (IoT) and machine-to-machine communications in these bands. This may help enabling growth and innovation in Machine-to-Machine (M2M) and Internet of Things (IoT) applications. The use of lower frequencies, particularly below 1 GHz, can make it easier for short range applications like M2M and metropolitan mesh machine (M3M) networking to reach those indoor locations that cannot be reached using the higher frequency bands.

An example of such a consultation process can be found in two national consultations conducted by Ofcom for the United Kingdom.

The United Kingdom consulted⁷ on a proposal for licence exemption for a range of apparatus in the 870 to 876 MHz and 915 to 921 MHz Bands. The consultation noted that these frequency bands will enable the authorisation by licence exemption of certain Short Range Devices (SRDs) in the frequency bands 870 to 876 MHz and 915 to 921 MHz. These could be used to provide new and improved wireless services such as smart metering and other machine-to-machine communications as well as more effective tracking of goods using RFID technologies. The consultation noted that this spectrum remained largely unused following the withdrawal of government and other services.

The consultation noted that, given the progress made in Europe with new harmonising measures for SRDs and Radio Frequency Identification (RFID) devices by the CEPT and ETSI, as well as evidence from the responses to an earlier UK consultation, the UK should make the bands 870 to 876 MHz and 915 to 921 MHz available on a licence exempt basis consistent with the CEPT's harmonised technical measures so long as those measures permit the efficient use of the spectrum.

The measures the UK proposed for SRDs and RFIDs in these bands are those published both in ECC Report 189 [8] and in ERC/REC 70.03 [5].

The UK consultation noted that the ECC proposals considered certain national non-SRD uses in these bands. Further, the ECC technical measures include the necessary and sufficient limitations on SRDs to ensure that national, non-SRD uses can be protected. In the UK, two non-SRD uses were considered: Meteorological Wind Profiling Radars operating in the West of England, centred on 915 MHz and the potential use of the Extended-GSM-R for rail communications (including potential use for new high speed rail links) in the bands 873-876 MHz and 918-921 MHz.

However, after carefully analysing the technical studies carried out by the CEPT in ECC Reports 200 [9] and 189, the UK considered that, based on the likely deployment scenarios of SRDs and RFIDs, the condition of having a low capacity to cause interference with other uses and users of the spectrum is met. In June 2014 the UK exempted from licencing the majority of SRD applications listed in ERC/REC 70.03. However, the UK proposed not to exempt from licensing the higher Duty Cycle Network Relay Points (NRPs) proposed in ECC Report 189.

The UK concluded that a general authorisation by light licence was the most appropriate regulatory mechanism. The United Kingdom made the 870-876 MHz band available for the deployment of NRPs from 12 January 2015, subject to a light licence, but without restrictions on deployment density. The UK Public

⁷ http://stakeholders.ofcom.org.uk/binaries/consultations/short-range-devices/summary/872_915_MHz.pdf

Consultation⁸ on NRPs determined that the use of polite spectrum access techniques, such as LBT and APC, as required by EN 303 204 [32], and the self-limiting effects of rising traffic on the feeder nodes would make regulating density limits unnecessary in the United Kingdom at this time. However, this decision may be reviewed depending on how the situation develops in the future.

The Ofcom consultation noted that some short range IoT and M2M devices use Wi-Fi at 2.4 GHz to link smart meters to energy consumption indicators in the home. However, 2.4 GHz has poor building penetration properties and so is not well suited for many meter locations in homes and businesses. These problems can be alleviated by allowing sub 1GHz frequencies to be used.

Network Relay Points (NRP's) are used in some systems. They aggregate and concentrate data they receive from and send to numerous consumer devices. The NRP's will, therefore, be more actively transmitting than an individual consumer device.

The Ofcom consultation was clear that higher duty cycle NRPs (up to 10%) in the 870-873 MHz band will need to incorporate interference mitigation techniques. Therefore, Ofcom has continued to support the European standardisation process for SRDs and the development of suitable mitigation techniques that allow higher duty cycle NRPs to be permitted in the 870-873 MHz band alongside other SRD uses.

The UK consultation proposed to create a light licence that permits a system operator to use NRPs with a duty cycle of between 2.5% and 10% in the 870-873 MHz band. The licensee is required to:

- keep records of where they deploy higher duty cycle NRPs;
- and
- ensure that higher duty cycle NRPs use Adaptive Power Control (APC).

Higher duty cycle NRP's covered by the light licence share with lower duty cycle NRPs and other SRDs which can use the 870- 876 MHz band.

Ofcom anticipated reviewing the situation in future as the demand for higher duty cycle NRPs should become more clear.

France started a national consultation process, see ANNEX 4:.

⁸ <http://stakeholders.ofcom.org.uk/binaries/consultations/network-relay-points/summary/network-relay-points.pdf>

ANNEX 2: REPLIES TO CEPT QUESTIONNAIRE ON THE USE IN 870-876 MHz/915-921 MHz

Replies were received from 43 administrations by 1 August 2012.

A2.1 EXISTING USAGE IN 870-876 / 915-921 MHz

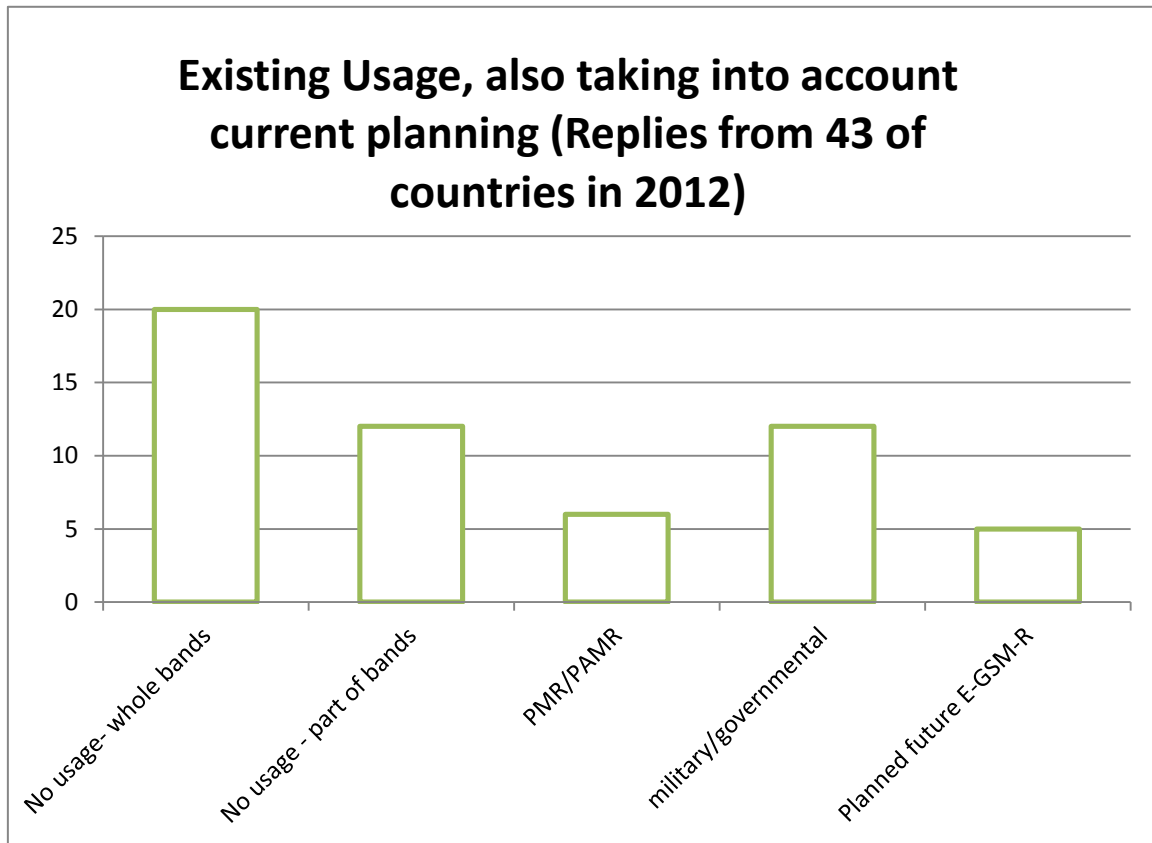


Figure 10: Existing Usage in 870-876 MHz/915-921 MHz

This overview shows that the real implementation of PMR/PAMR is not high in Europe, despite of having ECC/DEC/(04)06 [6] and reflection in the ECA table (ERC Report 25 [18]) over several decades. PMR/PAMR systems were only used in six countries in these frequency bands and several countries reported that PMR/PAMR has been allocation in their country but that network operation either has been terminated, or the network rollout being very limited, or network not fully put into operation, or either is simply unused (no licences awarded). One country plans to move from defence system usage towards PMR/PAMR usage. The PMR/PAMR usage is in some cases only in parts of the band (Georgia only 870-876 MHz, Poland 870-874.44 MHz). Ukraine reported to terminate usage by 1 January 2016.

There is considerable military usage in the band. Five countries (Austria, Belgium, Germany, Liechtenstein and Switzerland) were at mid-2013 also planning with ER-GSM, although this needs still to materialise in the market.

The ARNS situation (time limited according to RR 5.323 [39]) may apply also to Azerbaijan who did not answer the questionnaire (this is not explicitly recorded since ARNS is being phased out).

A2.2 INDIVIDUAL COUNTRY RESPONSES

Table 17: Responses received by 1 August 2012

Country	What is the current use of the bands 870-876 / 915-921 MHz in your country?	What are your short, medium and long term plans with regard to the future
Albania	870-876 and 915-921 MHz bands are identified as the favourite for Tactical Radio Relay, especially for cross-border cooperation	No change plans.
Andorra	Usage PMR/PAMR designated but not implemented	No change planned
Austria	Currently, the sub band 873-876 / 918-921 MHz is used according to the amended ECC/DEC/(02)05 for the extension of the GSM-R band. The sub band 870-873 / 915-918 MHz is currently not used (foreseen for PMR systems). Any European harmonisation measures are welcomed	No changes are foreseen with respect to the extension band for GSM-R. Concerning the other part of this band the Austrian Administration can follow any additional harmonisation measures in principal.
Belarus	ARNS (time limited), PMR/PAMR allocated but not used	No further plans
Belgium	Governmental use (e.g. Unmanned Aeronautical Vehicle, Unmanned Ground Vehicle or Tactical Radio Relay)	ER-GSM (also reflected in ECC/DEC/(04)06 and ECC/DEC/(02)05)
Bosnia Herzegovina	PMR/PAMR as per Rule 50/2010 which transponded stipulations of ERC T/R 25-05. However, No licensed issued nor planned	No plans for change at the moment
Bulgaria	The whole band 870-876 / 915-921 MHz (2x6 MHz) is used by governmental applications (defence usage). Governmental usage will stay in the future and will not change	No change
Croatia	Military services, PMR/PAMR/ ER-GSM. No PMR/PAMR networks are implemented/ in operation in the market and intention to close the governmental use in this band	Indicated that only ER-GSM is planned. However, Croatia has not deployed GSM-R in the GSM-R core band yet
Cyprus	The frequency bands are currently being used according to the frequency plan by the government (TRR, lower half of duplex band) and by digital land mobile PMR/PAMR (no licenses awarded)	No future use planned yet.
Czech Republic	The guard bands 870-872 / 915-917 MHz are not used and are not designated for any application. The bands 872-875.8 / 917-920.8 MHz are designated for applications in accordance with ECC/DEC/(04)06 (i.e. category 2). Current holder of block assignment has terminated operation of CDMA network however licence is valid until 2015.	Short plans: There is no short plan until there is information about future plan from the licence holder. Medium plans and long term plans: The CTO has no specific plans; however, future utilisation will reflect European harmonisation, if required

Country	What is the current use of the bands 870-876 / 915-921 MHz in your country?	What are your short, medium and long term plans with regard to the future
	The bands 875.8-876 / 920.8-921 MHz are guard bands (no utilisation)	
Denmark	No use	SRD and RFID
Estonia	No use. Reserved until public competition	Waiting for results of international working groups. Will not decide plans with regard to the future use before decisions are made in international level
Finland	Governmental use until the end of 2013. Designated for PMR/PAMR according to ECC/DEC/(04)06 but no actual PMR/PAMR users on these bands. Other usage: test networks	Ficora supports CEPT studies on additional UHF spectrum for SRD, RFID and smart metering applications. Based on these studies these frequency bands may be considered for these applications
France	Governmental use for several kind of applications such as unmanned systems (air, sea and ground), remote control and telemetry, data links, etc.	A governmental usage of those bands will be maintained in the future. Sharing of the 870-873 MHz band with secondary SRD applications is not considered at this stage
Georgia	870-876 MHz band is used by CDMA-850 systems and radio-microphone devices. 915-921 MHz is currently used by SRD applications and radio-modems	No change planned
Germany	870-873 / 915-918 MHz. Governmental use (implemented, exclusive usage). 873-876 MHz / 918-921 MHz. ER-GSM (license awarded), PMR/PAMR licenses possible but not awarded	No change planned
Greece	Exclusively Governmental Use (Tactical Communication System, Radio Relay)	No change planned
Hungary	Not used at present	2. 870-873 / 915-918 MHz planned for wide band PMR/PAMR land mobile radiotelephone systems. 2. & 3. 873-876 / 918-921 MHz planned for wide band PMR/PAMR land mobile radiotelephone systems, including ER-GSM systems. However, deployment in GSM-R core band still in planning phase
Iceland	Fixed (point to point links)	Short term plan: Fixed (point to point links) No medium or long term plans
Ireland	The bands 872-876 / 917-921 MHz, are licensed within Ireland until December 2015 for Wideband Digital Mobile Data Services. The network has not yet been built up, and has minimal operation within Ireland (limited only to north county Dublin). The technology used is flash ofdm. 870-872 / 915-917 MHz are currently unused in Ireland	ComReg has not yet determined its plans with regard to future use within these bands; however, a review of future use of the bands has been included in ComReg's work programme for the period 2011 – 2013, for attention towards the end of this period.
Italy	MOBILE NETWORK by DEFENCE and SECURITY BODIES AND C2 UAV	No changes planned

Country	What is the current use of the bands 870-876 / 915-921 MHz in your country?	What are your short, medium and long term plans with regard to the future
	(whole 2 x 6 MHz)	
Latvia	<p>Identified for Wide Band Digital Land Mobile PMR/PAMR systems (according to ECC/DEC/(04)06)</p> <p>At this moment the band is not used</p>	<p>Short term (3-5 years): Wide Band Digital Land Mobile PMR/PAMR systems (according to ECC/DEC/(04)06).</p> <p>Long term (5-10 years): No changes or adjustment to harmonised use of the band in Europe</p>
Liechtenstein	<p>870-873 MHz: Until today no RIS and no use.</p> <p>873-876 MHz: RIS RIR0501-01 and RIR0501-05.</p> <p>Land mobile/GSM; individual assignment due shortly</p> <p>915-918 MHz: Until today no RIS and no use.</p> <p>918-921 MHz: RIS RIR0501-03 and RIR0501-05.</p> <p>Land mobile/GSM; Individual assignment due shortly</p>	<p>Short and Medium term plans: 870-873 MHz: Reserved for future use by SRDs. 873-876 MHz: Primary allocation to GSM-R and use by GSM-R. 915-918 MHz: reserved for future use by SRDs. 918-921 MHz: Primary allocation to GSM-R and use by GSM-R.</p> <p>Long term plans: 870-873 MHz: Reserved for future use by SRDs. 873-876 MHz: Primary allocation to Railway mobile communication systems. 915-918 MHz: Reserved for future use by SRDs. 918-921 MHz: Primary allocation to Railway mobile communication systems</p>
Lithuania	No use	PMR/PAMR according to ECC/DEC/(04)06
Luxembourg	<ol style="list-style-type: none"> 1. Although the frequency band is a shared civil/military band, no military application (such as tactical radio relay) is currently in use. 2. The frequency band has been allocated to PMR/PAMR applications (in accordance with ECC/DEC/(04)06) for some years, but no licences have yet been granted. 3. Currently there is no intention to extend the GSM-R frequency range to include as well the band 873-876 / 918-921 MHz. 4. Luxembourg recently granted a temporary licence for the band 870-876 MHz to an energy utility company for utilisation of smart grid applications 	In Luxembourg, there is a request for this band for smart metering applications, which is mainly intended for carrying out tests of the relevant radio equipment.
Former Yugoslavian Republic of Macedonia	The bands 870-876 / 915-921 MHz are allocated for Fixed and Land Mobile Service (no licenses awarded)	Plans for GSM-R / PMR/PAMR, however deployment in GSM-R core band still in planning phase
Malta	Not used	No plans
Moldava	870-876 MHz – SRD possible; 915-921 MHz in pair with 870-876 MHz for PMR/PAMR is provided by National Radiofrequency Table, but there are no registered or operating PMR/PAMR	No plans

Country	What is the current use of the bands 870-876 / 915-921 MHz in your country?	What are your short, medium and long term plans with regard to the future
	networks	
Montenegro	Digital PMR/PAMR (no license awarded) and TRR (Tactical radio relay) in lower half of the band	In further planning of this band, the most recent technological trends shall be taken into consideration, as well as the experience of the CEPT member countries and realistic needs of Montenegrin users
Norway	870.5-876 / 915.5-921 MHz designated for individual service neutral license. No current use	Awaiting international harmonisation
Poland	870-874.44 MHz: individual licensed PMR/PAMR applications, 869.4-874.44 MHz (downlink) paired with 824.4-829.44 MHz (uplink), CDMA, CDMA 2000 1xEV-DO); 874.44-876 MHz not used 915-921 MHz not used	Medium or long term plans: a) re-farming (release) of the frequency range 870-874.44 MHz - moving CDMA and CDMA 2000 1xEV-DO applications into another frequency band. b) introduction of harmonised frequency usage in the bands 870-876 / 915-921 MHz in accordance with CEPT (and/or EU) regulations, e.g. extension of GSM-R band (ER-GSM i.e. 873-876 / 918-921 MHz)
Portugal	870-873 MHz is being tested for a smart metering system, by the energy distribution operator; 873-876 MHz paired with 918-921 MHz is being used by military	Some adjustments might occur on the quantity of spectrum in use in the 870-876 / 915-921 MHz band in the short/medium term. GSM-R extension would be possible inside core GSM-R band since only 2x2 MHz being used currently
Russian Federation	Band 870-876 MHz ARNS on primary basis Band 915-921 MHz ARNS on primary basis Space operation service for telemetry, tracking, and control purposes Mobile, except aeronautical mobile on secondary basis. Band 916-921 MHz RFID	Decommissioning of ARNS after the end of depreciation period and deployment same service in other bands
Serbia	Defence Systems	Medium term plan is to use the band for PMR/PAMR
Slovak Republic	872-876 MHz digital wideband cellular network - CDMA; (duplex +45 MHz). 917-921 MHz digital wideband cellular network - CDMA, duplex -45 MHz; (General license for terminals)	Yes, but only for frequency sectors 870-872 / 915-917 MHz and it also depends on results of study of compatibility.
Slovenia	Land military systems in 870-873 MHz (MS) /915-918 MHz (BS). PMR/PAMR possible in upper half of the band but no licenses awarded	Extension of land military systems or PMR/PAMR for the upper half of the band
Spain	There are 4 local licences in Spain, broadband digital technology for applications as M2M, meter reading and	No change planned

Country	What is the current use of the bands 870-876 / 915-921 MHz in your country?	What are your short, medium and long term plans with regard to the future
	data. Technologies could be LTE or WiMax	
Sweden	No use	No short term plans for this band. Awaiting the results of the EC Spectrum Inventory
Switzerland	<p>870-873 MHz: Until today no RIS and no use.</p> <p>873-876 MHz: RIS RIR0501-01 and RIR0501-05.</p> <p>Licences will be assigned shortly</p> <p>915-918 MHz: Until today no RIS and no use.</p> <p>918-921 MHz: RIS RIR0501-03 and RIR0501-05.</p> <p>Licences will be assigned shortly</p>	<p>Short and Medium term plans:</p> <p>870-873 MHz: Reserved for future use by SRDs.</p> <p>873-876 MHz: Primary allocation to GSM-R and use by GSM-R.</p> <p>915-918 MHz: Reserved for future use by SRDs.</p> <p>918-921 MHz: Primary allocation to GSM-R and use by GSM-R.</p> <p>Long term plans:</p> <p>870-873 MHz: Reserved for future use by SRDs.</p> <p>873-876 MHz: Primary allocation to Railway mobile communication systems.</p> <p>915-918 MHz: Reserved for future use by SRDs.</p> <p>918-921 MHz: Primary allocation to Railway mobile communication systems</p>
The Netherlands	Military	Military use for the foreseeable future, new equipment has recently been purchased
Turkey	<p>870-876 MHz: Designated to PMR/PAMR and Fixed Links. No implementation yet</p> <p>915-921MHz: Designated for PMR/PAMR. No implementation yet.</p>	No plans yet
Ukraine	<p>In accordance with the Plan of radio frequency resource usage in Ukraine the band of 870-876 MHz is actually used by REFs of CDMA-800 cellular communication systems, to organise of BS->AS communication links (deadline of technology usage – 1st January, 2016).</p> <p>Besides, both specified bands are used by special users REFs, relating to radio navigation and radiolocation service (for example, RSBN/PRMG), and will be used till the end of its operation term.</p>	For a present day, there are no plans concerning conversion of the bands 870-876 / 915-921 MHz in future, after the termination of their use by mentioned REFs
United Kingdom	The Met Service operates Wind Profiler Radar (1 site) in the 915 MHz band. The use of this technology will continue and further sites may be added in future.	The UK has consulted on the use of the bands and has subsequently decided to permit a range of SRD based on the forthcoming entries in ERC/REC 70-03.

Table 18: Use of 870-876 MHz and 915-921 MHz as indicated by CEPT administrations in 2012

	870/915	871/916	872/917	873/918	874/919	875/920	876/921
Andorra							
Albania							
Austria				ER-GSM			
Belarus	ARNS (phased out)						
Belgium				ER-GSM			
Bosnia Herzegovina							
Bulgaria							
Croatia				ER-GSM planned, however GSM-R not deployed in GSM-R core band yet.			
Cyprus							
Czech Republic			Usage terminated				
Denmark							
Estonia							
Finland	Governmental use terminates						
France¹³	Note: French comment from the WGFM #75 minutes Minsk ⁹						

	Not used or going to be unused
	Planned ER-GSM
	Usage based on PMR/PAMR licenses
	Governmental/military usage

⁹ Germany emphasised during the WGFM#75 meeting in Minsk that the bands 870-873 MHz and 915-918 MHz are designated exclusively for military radio applications and that it cannot be expected that they can be made available e.g. for short range device applications in the foreseeable future. France has the similar situation in the band 870-873 MHz. Other sub-bands outside of these mentioned frequencies may be considered for partial implementations.

Georgia	870-876: CDMA-850 Network, 915-921 possible for SRD/RFID	
Germany¹³		ER-GSM
Greece		
Hungary		ER-GSM planned, however deployment in GSM-R core band still ongoing
Iceland	Limited p-t-p links, time-limited	
Ireland		
Italy		
Latvia		
Liechtenstein		ER-GSM
Lithuania		
Luxemburg	Request for Smart Metering	
FYROM		ER-GSM planned but GSM-R in the care band only in planning phase yet
Malta		
Moldava		
Montenegro		
Norway		
Poland	870-874.44 MHz CDMA 2000 EV-DO, rest unused	
Portugal	Request for Smart Metering	
Russian	RFID 916-921 MHz, (ARNS phased out), satellite TTC	

Federation	
Serbia	Medium term plan to move from defence systems to PMR/PAMR
Slovak Republic	CDMA Network
Slovenia	
Spain	4 local licenses for M2M, Metering based
Sweden	
Switzerland	ER-GSM
The Netherlands	
Turkey	
Ukraine	
UK	Plus Wind Profiler (a site) and unused military allocation

ANNEX 3: DETAILED PROPOSAL FOR INCLUSION IN THE TECHNICAL ANNEX OF THE EC DECISION FOR SRD

Table 19: Proposals for inclusion in the technical annex of the EC Decision for SRD

Band no	Frequency band ⁽ⁱ⁾	Category of short-range devices ⁽ⁱⁱ⁾	Transmit power limit/ field strength limit/power density limit ⁽ⁱⁱⁱ⁾	Additional parameters (channelling and/or channel access and occupation rules) ^(iv)	Other usage restrictions ^(v)	Market demand/Considerations
New	863-868 MHz	Wideband data transmission devices ⁽¹⁶⁾	25 mW e.r.p.	<p>Techniques to access spectrum and mitigate interference that provide at least equivalent performance to the techniques described in harmonised standards adopted under Directive 2014/53/EU must be used</p> <p>Bandwidth: ≤ 1 MHz</p> <p>Duty cycle ^(vi): $\leq 10\%$ for network access points ^(x1)</p> <p>Duty cycle ^(vi): $\leq 2.8\%$ otherwise</p>	This set of usage conditions is only available for wideband SRD in data networks ^(x1)	<p><u>WBN SRD 25 mW / 1 MHz in 863-868 MHz:</u></p> <p>5 MHz of spectrum for wideband SRD in data networks - see IEEE 802.11ah [12] or equivalent.</p> <p>The harmonised standard should define the minimum requirements for the spectrum access protocol, e.g. CSMA-CA or equivalent.</p>
47b	865-868 MHz	Non-specific short-range devices ⁽³⁾	<p>500 mW e.r.p.</p> <p>Transmissions only permitted within the bands 865.6-865.8 MHz, 866.2-866.4 MHz, 866.8-867.0 MHz and 867.4-867.6 MHz</p> <p>Adaptive Power Control (APC) required, alternatively other mitigation techniques which achieve at least an equivalent</p>	<p>Techniques to access spectrum and mitigate interference that provide at least equivalent performance to the techniques described in harmonised standards adopted under Directive 2014/53/EU must be used</p> <p>Bandwidth: ≤ 200 kHz</p> <p>Duty cycle ^(vi): $\leq 10\%$ for network access points ^(x1)</p> <p>Duty cycle ^(vi):</p>	This set of usage conditions is only available for data networks ^(x1)	<p><u>WAN NBN SRD 500 mW / 200 kHz in 865-868 MHz:</u></p> <p>4x200 kHz can be used for 500 mW data networks.</p> <p>The harmonised standard should define the Adaptive Power Control mechanism in line with ECC Report 261. Future investigations may identify alternative mitigation techniques to provide also alternatives in support of innovative networks and related technical aspects.</p>

Band no	Frequency band ⁽ⁱ⁾	Category of short-range devices ⁽ⁱⁱ⁾	Transmit power limit/ field strength limit/power density limit ⁽ⁱⁱⁱ⁾	Additional parameters (channelling and/or channel access and occupation rules) ^(iv)	Other usage restrictions ^(v)	Market demand/Considerations
			level of spectrum compatibility	≤ 2.5% otherwise		
New	874-875.6 MHz ^(x5)	Non-specific short-range devices ⁽³⁾	500 mW e.r.p. Adaptive Power Control (APC) required, alternatively other mitigation techniques which achieve at least an equivalent level of spectrum compatibility	Techniques to access spectrum and mitigate interference that provide at least equivalent performance to the techniques described in harmonised standards adopted under Directive 2014/53/EU must be used Bandwidth: ≤ 200 kHz Duty cycle ^(vi) : ≤ 10% for network access points ^(x1) Duty cycle ^(vi) : 2.5% otherwise	This set of usage conditions is only available for data networks All devices within the data network shall be under the control of network access points ^(x1, x2, x3, x4)	<u>WAN NBN SRD 500 mW / 200 kHz in 874-876 MHz:</u> 1.6 MHz can be used for 500 mW data networks. The harmonised standard should define the Adaptive Power Control mechanism in line with ECC Report 261. Future investigations may identify alternative mitigation techniques to provide also alternatives in support of innovative networks and related technical aspects. The notes ^(x2) and ^(x3) imply a difference compared with the proposed entry in the band 865-868 MHz on the RFID interrogator channels for NBN SRD due to the different spectrum environment and the need to ensure protection of radio services. See ^(x5) : For countries considering the future railway mobile communication system use in 875.1-876 MHz, it is recommended to consider implementation in the frequency range between 870.0 MHz and 875.1 MHz.
New	918-920.8 MHz ^(x6)	Wideband data transmission devices ⁽¹⁶⁾	25 mW e.r.p	Techniques to access spectrum and mitigate interference that provide at least equivalent performance to the techniques described in harmonised standards adopted under Directive 2014/53/EU must be used Bandwidth: ≤ 1 MHz	This set of usage conditions is only available for wideband SRD in data networks All devices within the data network shall be under the control of network access points ^(x1, x2, x3)	<u>WBN SRD 25 mW / 1 MHz in 918-921 MHz:</u> 2.8 MHz of spectrum for wideband SRD in data networks - see IEEE 802.11ah [12] or equivalent. The harmonised standard should define the minimum requirements for the spectrum access protocol, e.g. CSMA-CA or equivalent. The notes ^(x2) and ^(x3) imply a difference compared with

Band no	Frequency band ⁽ⁱ⁾	Category of short-range devices ⁽ⁱⁱ⁾	Transmit power limit/ field strength limit/power density limit ⁽ⁱⁱⁱ⁾	Additional parameters (channelling and/or channel access and occupation rules) ^(iv)	Other usage restrictions ^(v)	Market demand/Considerations
				Duty cycle ^(vi) : $\leq 10\%$ for network access points ^(x1) Duty cycle ^(vi) : $\leq 2.8\%$ otherwise Geographical restrictions may be applied where ER-GSM protection is necessary		<p>the proposed entry in the band 863-868 MHz for wideband data transmission systems due to the different spectrum environment and the need to ensure protection of radio services. It is however believed that the actual application scope for such systems is so wide that the two entries complement each other, i.e. there are consumer-like applications on one side (863-868 MHz) as well as more professional implementations for which this entry may be the choice.</p> <p>See ^(x6): For countries considering future railway mobile communication system use in 920.1-921.0 MHz, it is recommended to consider implementation in the frequency range between 915.8 MHz and 920.1 MHz.</p>
New	915-921 MHz	Non-specific short-range devices ⁽³⁾	500 mW e.r.p. Transmissions only permitted within the bands 917.3-917.7 MHz, 918.5-918.9 MHz and 919.7-920.1 MHz Adaptive Power Control (APC) required, alternatively other mitigation techniques which achieve at least an equivalent level of spectrum compatibility	Techniques to access spectrum and mitigate interference that provide at least equivalent performance to the techniques described in harmonised standards adopted under Directive 2014/53/EU must be used Bandwidth: ≤ 200 kHz Duty cycle ^(vi) : $\leq 10\%$ for network access points ^(x1) Duty cycle ^(vi) : \leq	This set of usage conditions is only available for data networks All devices within the data network shall be under the control of network access points ^(x1, x2, x3, x4)	<p><u>WAN NBN SRD 500 mW / 200 kHz in 915-921 MHz:</u></p> <p>An amount of 3 times 400 kHz can be used with a bandwidth of ≤ 200 kHz for 500 mW data networks.</p> <p>The harmonised standard should define the Adaptive Power Control mechanism in line with ECC Report 261. Future investigations may identify alternative mitigation techniques to provide also alternatives in support of innovative networks and related technical aspects.</p> <p>The notes ^(x2) and ^(x3) imply a difference compared with the proposed entry in the band 865-868 MHz on the RFID interrogator channels for NBN SRD due to the different spectrum environment and the need</p>

Band no	Frequency band ⁽ⁱ⁾	Category of short-range devices ⁽ⁱⁱ⁾	Transmit power limit/ field strength limit/power density limit ⁽ⁱⁱⁱ⁾	Additional parameters (channelling and/or channel access and occupation rules) ^(iv)	Other usage restrictions ^(v)	Market demand/Considerations
				2.5% otherwise		to ensure protection of radio services.
New	915-921 MHz	Radio Frequency Identification (RFID) ⁽¹²⁾ devices	Interrogator transmissions at 4 W e.r.p. only permitted at the centre frequencies 916.3 MHz, 917.5 MHz, 918.7 MHz and 919.9 MHz	Techniques to access spectrum and mitigate interference that provide at least equivalent performance to the techniques described in harmonised standards adopted under Directive 2014/53/EU must be used For ER-GSM protection (918-921 MHz), Detect-And-Avoid (DAA) is required Bandwidth: ≤ 400 kHz	(x2, x3, x4)	<u>4W UHF RFID :</u> 4x400 kHz can be used for 4W UHF RFID. Larger channels, higher power and better tuning will support greater performance for UHF RFID. The notes ^(x2, x3, x4) imply: There is a difference compared with the UHF RFID usage in the band 865-868 MHz due to the different spectrum environment and the need to ensure protection of radio services.
New	918-920.8 MHz ^(x6)	Non-specific short-range devices ⁽³⁾	25 mW e.r.p.	Techniques to access spectrum and mitigate interference that provide at least equivalent performance to the techniques described in harmonised standards adopted under Directive 2014/53/EU must be used Channel bandwidth ≤ 600 kHz Duty cycle ^(vi) : ≤ 1%, Member states may consider, for ER-GSM protection (918-921 MHz), to limit the duty cycle to ≤ 0.01%	This set of usage conditions is only available for SRD in data networks All devices within the data network shall be under the control of network access points ^(x1, x2, x3)	<u>Non-specific SRD:</u> The harmonised standard should define the minimum requirements to ensure that duty cycles restrictions are accomplished by such networks and that end points are under the control of network access points. The notes ^(x2) and ^(x3) imply a difference compared with the opportunities in the band 863-870 MHz for non-specific SRD due to the different spectrum environment and the need to ensure protection of radio services. It is however believed that the actual application scope for such systems is so wide that the entries complement each other, i.e. there are consumer-like applications on one side (863-870 MHz) as well as more professional implementations for which

Band no	Frequency band ⁽ⁱ⁾	Category of short-range devices ⁽ⁱⁱ⁾	Transmit power limit/ field strength limit/power density limit ⁽ⁱⁱⁱ⁾	Additional parameters (channelling and/or channel access and occupation rules) ^(iv)	Other usage restrictions ^(v)	Market demand/Considerations
				and the maximum transmit on-time to 5ms/1s or, alternatively, to apply geographical restrictions		this entry maybe the choice. See ^(x6) : For countries considering future railway mobile communication system use in 920.1-921.0 MHz, it is recommended to consider implementation in the frequency range between 915.8 MHz and 920.1 MHz.

- ^(x1) A network access point in a data network is a fixed terrestrial short range device that acts as a connection point for the other short range devices in the data network to service platforms located outside of that data network. The term data network refers to several short range devices, including the network access point, as network components and to the wireless connections between them.
- ^(x2) A general authorisation regime is recommended. However, Member States may limit usage of this entry such that installation and operation are performed only by professional users (professional use can be defined on a national basis) and may consider individual authorisation, e.g. to administer geographical sharing and/or the application of mitigation techniques to ensure protection of radio services.
- ^(x3) In countries where parts or all of this frequency range are used by military applications and coordination is not possible, Member States may decide not to implement this entry partially or in its entirety in accordance with Article 1(4) of Decision 676/2002/EC.
- ^(x4) National rules, such as local coordination, may also be needed in order to avoid interference to radio services operating in the adjacent bands, e.g. due to intermodulation or blocking.
- ^(x5) This frequency range 874-875.6 MHz is preferred. Member States may alternatively implement at least 1.6 MHz within the whole frequency range 870.0-875.6 MHz depending on national circumstances, e.g. by considering the future railway mobile communication system.
- ^(x6) This frequency range 918-920.8 MHz is preferred. Member States may alternatively implement at least 2.8. MHz within the whole frequency range 915.8-920.8 MHz depending on national circumstances, e.g. by considering the future railway mobile communication system.

ANNEX 4: NATIONAL INFORMATION AND OPINIONS FROM CEPT ADMINISTRATIONS

A4.1 GERMANY: INFORMATION ABOUT USE OF ER-GSM

In Germany, the bands 870-876 MHz and 915-921 MHz are shared by the civil and the military side according to the national frequency allocation table. Based on an agreement with the military side, on a national basis, the German railway DB has been licensed in 2008 to use the 873-880 MHz / 918-925 MHz bands for GSM-R. This current right of use expires in 2020. Because the German frequency plan does not contain any limitation in time for the 2 x 7 MHz, designated to GSM-R, a prolongation of the licence currently in force is expected. The use of the ER-GSM frequencies is planned for national operational purposes. This includes for example the migration of legacy PMR usage from the VHF and UHF PMR bands into the GSM-R system of DB.

A consistently high quality of voice communications (i.e. low interference and high speech quality) is needed for emergency calls, shunting communication and other railway radio communications. This is particularly important in the case of group calls where multiple users are involved across a number of different GSM-R radio cells. The migration of shunting communications from analogue radio to GSM-R shunting radio with the use of the ER-GSM bands is still an ongoing project at DB.

In addition to the shunting radio, there are a variety of different types of railway operational radio applications. These applications are vital to the smooth operation of the railway and include group and individual calls between train drivers and controllers, calls between members of maintenance teams, calls between security staff as well as other group calls and broadcast calls.

After a long-term preparation and a European-wide tender DB is in an ongoing nation-wide reinvest programme for all GSM-R base stations since 2015. The programme involves the total length of more than 29 000 km of the German railway network with GSM-R radio coverage. The following map shows the current first-generation GSM-R radio network (more than 3800 radio sites) and the regions with the lack of frequencies (the available 19 GSM-R radio frequency carriers provided by the first-generation frequency designation are not enough for the traffic demands).



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Figure 11: Indicative Regions where ER-GSM usage is needed

Additionally, each national border region can be considered critical. The 19 carriers provided by the current frequency designation ('core' GSM-R band) are not completely available at the national borders. In the regions with the lack of frequencies, the migration of shunting and other operational radio communication

from analogue radio to digital GSM-R shunting radio is suspended or a temporary hybrid solution with analogue radio and digital GSM-R shunting radio has been installed. This rough and ready solution has unwanted consequences in operational processes for shunting teams as communication equipment has to be changed during critical phases of shunting operations. Note that DB also operates some GSM-R base stations in Switzerland in the Basel region.

DB has selected in July 2015 two consortiums to perform a migration of its first-generation GSM-R network. The new network is compliant with EIRENE GSM-R and ETCS2/ERTMS standards, interoperability and new GSM-R functions. The new GSM-R equipment also features the use of GPRS.

The ER-GSM bands are an integral part of the programme.

Sub-Contractors for this programme are selected. With this new generation of base stations DB is in the position to shift national railway PMR traffic towards the frequencies in the ER-GSM band.

The base station technology will be rolled out from beginning 2017 in test areas under railway-operational conditions. The ER-GSM network planning is in progress in parallel. After finalising these operational tests and the network planning, the nation-wide rollout will start at about 2018.

It can be expected that the GSM-R technology currently under procurement will be used at least until 2030 by DB.

Besides that, it should be noted that GSM-R communication enables European railway corridors, since the national GSM-R communication can be separated from the international one.

A4.2 NATIONAL SITUATION IN THE NETHERLANDS

Opening the frequency bands 915-921MHz and 870-876 MHz for SRD's in the Netherlands at this moment is problematic and to a large extent also not necessary. The following explains why.

In the Netherlands the 915-921MHz and 870-876 MHz bands are used for defence and national security applications. In most countries the bands are used as NATO tuning ranges only to be used in time of conflict or during military exercises. In The Netherlands a number of applications related to national security are placed in these frequency bands making it more difficult and in many cases even impossible to share with SRD's

Discussions with the incumbent users however are going on and may lead to the possibility to have part of the spectrum available for some specific applications such as RFID in the future

We realise that here is pressure from industry to have more spectrum below 1GHz available. We feel that the reasons for this are threefold. The first reason is better possibilities for networked SRD's with relatively large coverage base stations such as IoT. The second reason is better wall penetration of SRDs used in for example cellars such as needed for certain smart metering technologies. The third reason is RFID source tagging in combination with bulk scanning.

In 2016 The Netherlands commissioned a research and publication of a report about "the wireless Internet of Things Spectrum utilisation and monitoring" [46]. The findings in this report can also be used for general networked SRD's below 1GHz and RFID systems below 1GHz.

The main conclusions of the report with respect to this topic are:

- We expect that the currently available spectrum is sufficient to handle the expected connectivity demand for wireless IoT;
- The use of unlicensed spectrum for mission-critical communications presents a risk with respect to televulnerability¹⁰;
- Many short-range IoT applications do not necessarily need to use spectrum below 1 GHz.

¹⁰ Televulnerability is a term used in The Netherlands and first used in the Ph.D. thesis of Eelco Vriesevink named „assessing Telecommunication Service Availability Risks for Crisis Organisations“

The main recommendation of the Report with respect to this topic is: We recommend the Agency not to allocate additional spectrum for LPWA IoT.

In the Netherlands smart metering applications are largely rolled out in a licenced band in the 400MHz range. The few utility operators using licence exempt solutions satisfactory use the 863-870MHz band or PLT technology.

In the Netherlands the two large IoT network operators use the high power segment (868 MHz) in the 863-870 MHz band without seeing capacity problems in the near future.

We agree therefore with the conclusions and recommendations of the research report and based on our previous remarks, the conclusion of this report and the principles of CEPT Report 14 [37] we see no need for opening the frequency bands in The Netherlands for general use.

We also see no need to harmonise these frequency ranges in Europe on the short term.

As said in a previous paragraph RFID bulk scanning may benefit from harmonisation of the 915-921MHz frequency range. For those specific bulk scanning scenarios an exception could be made since the locations where this type of scanning is necessary are limited and planning and coordination is probably possible. This needs to be technically studied in the Netherlands. The RFID case is also treated in the research report but not included in the conclusions since the main topic of the report was IoT.

Conclusion:

In the Netherlands there is at this moment no need for additional spectrum for certain types of SRD and therefore welcomes the flexible approach in as much spectrum as possible in the 915-921 and 870-876 MHz frequency ranges.

Possibilities to open parts of the bands 915-921 and 870-876 for certain types of SRD will be investigated in the future.

A4.3 NATIONAL SITUATION IN FRANCE

In France, Arcep and ANFR conducted a public consultation (3rd June – 18th July 2016), to gather feedback from stakeholders on “new opportunities for using the 862-870 MHz, 870-876 MHz and 915-921 MHz bands” to meet the growing needs of the Internet of Things.

This consultation has revealed a very strong need for new frequencies, notably just below 1 GHz. More precisely, stakeholders emphasise on the opportunities, in a harmonised approach, to relax technical conditions on the use of the band 862-870 MHz and to make available portions of the bands 870-876 MHz and 915-921 MHz, to optimise their usage for SRDs, noting in particular the nearly worldwide harmonisation of the band 915-921 MHz.

A4.4 NATIONAL CONSULTATION AND STUDY IN THE UNITED KINGDOM

A study [31] commissioned by UK Spectrum Policy Forum, an important representative of technical industries based in London, United Kingdom, and including representation from Ofcom, commissioned an independent study to examine the role of SRDs in the delivery of future IoT services.

The study highlighted the many benefits that arise from licence exempt bands, a relatively small proportion of radio spectrum being available for such use and the shared nature of most of the bands. Much of the benefit is derived from the free circulation of licence exempt devices, throughout Europe and in many cases other parts of the world. This is particularly evident for technologies like Wi-Fi and Bluetooth, which enable a single low cost chipset to provide connectivity anywhere in the world, and RFID devices that are increasingly used to track goods in global freight operations.

The two main areas of demand growth likely to impact on licence exempt frequency bands in the future are broadband wireless access systems (WAS) and machine to machine (M2M) communications. In both cases, additional spectrum has been identified that should be sufficient to cater for projected long term demand.

The United Kingdom consulted¹¹ on a proposal for licence exemption for a range of apparatus in the 870 to 876 MHz and 915 to 921 MHz Bands. The consultation noted that these frequency bands will enable the authorisation of licence exempt use of certain Short Range Devices (SRDs) in the frequency bands 870 to 876 MHz and 915 to 921 MHz. These could be used to provide new and improved wireless services such as smart metering and other machine-to-machine communications as well as more effective tracking of goods using RFID technologies. The consultation noted that this spectrum remained largely unused following the withdrawal of government and other services.

The consultation noted that, given the progress made in Europe with new harmonising measures for SRDs and Radio Identification Devices (RFIDs) by the CEPT and ETSI, as well as evidence from the responses to an earlier UK consultation, the UK should make the bands 870 to 876 MHz and 915 to 921 MHz available on a licence exempt basis consistent with the CEPT's harmonised technical measures so long as those measures permit the efficient use of the spectrum.

The measures the UK proposed for SRDs and RFIDs in these bands are those published both in ECC Report 189 [8] and in ERC/REC 70.03 [5].

¹¹ http://stakeholders.ofcom.org.uk/binaries/consultations/short-range-devices/summary/872_915_MHz.pdf

ANNEX 5: SUMMARY ON RESPONSES FOR 870-876 MHz/915-921 MHz DURING THE PUBLIC CONSULTATION OF CEPT REPORT 59

During the public consultation for CEPT Report 59 [1], the following stakeholders supported further SRD harmonisation in CEPT Report 59, the majority of which expressed an interest in the availability of further sub- 1 GHz spectrum, especially in 870-876 MHz and 915-921 MHz, whilst the remaining respondents did not expressed respective interests:

From CEPT:

- United Kingdom: Discrete Time Communications Ltd,
 Bristol Is Open,
 SCF Associates Ltd (general support for greater SRD harmonisation, not specified to bands),
 Silver Spring Networks Ltd,
 EM-Lite Ltd (general support for greater SRD harmonisation, not specified to bands),
 Secure Meters Ltd,
 the Joint Radio Company Ltd (JRC) (at least partial harmonisation of 870-873/915-918MHz),
 ITRON Inc,
 TechUK
- France: EVESA (general support for greater SRD harmonisation, not specified to bands),
 Gridbee Communications,
 Lumnex,
 STREETLIGHT.VISION (general support for greater SRD harmonisation, not specified to bands)
- Portugal: ISA Energy (general support for greater SRD harmonisation, not specified to bands),
 ENLIGHT (general support for greater SRD harmonisation, not specified to bands),
 Net Plan -Telecomunicações e Energia, S.A. (some or all of the 870-876/915-921MHz spectrum)
- Germany: Renesas Electronics Europe GmbH,
 Sennheiser
- Ireland: Analog Devices
- The Netherlands: Greenpeak Technologies BV (general support for greater SRD harmonisation, not specified to bands),
- Norway: BKK Nett AS (request for the band 870-876 MHz only)

Outside CEPT:

- USA: Wi-SUN Alliance Inc.
- India: Eron Energy

The precise statements are included in document SRDMG(16)027 [40].

ANNEX 6: CONSIDERATIONS ON INTERMODULATION PRODUCTS INTERFERENCE INTO GSM-R FROM NBN SRD AND RFID IN THE VICINITY OF RAIL TRACKS

While ECC Report 200 [9] did include the adjacent band compatibility considerations for RFID and NBN SRDs, interference into GSM-R by intermodulation products was not considered in ECC Report 200.

As depicted in ECC Report 229 [49] and seen on field, GSM-R terminals can be affected by intermodulation products generated within the GSM-R receiver front-end from an MFCN wideband signal, two or more MFCN narrowband signals, or a combination of these. The same interference mechanism can potentially occur with 500mW NBN SRD (for which however, there is an APC requirement) and 4W RFID interrogators. RFID interrogators are typically installed quite close to the ground and not on masts. In Addition, special RFID installations for dense RFID use normally avoid emissions towards neighbouring RFID interrogators as much as necessary, e.g. by shielding. Hence, the occurrence of this interference mechanism may be seldom.

As GSM-R BS transmitting in the 918-921 MHz band may interfere public GSM BS receiving below 915 MHz, 500mW NBN SRD transmitting below 876 MHz may interfere GSM-R BS receiving above 876 MHz, in case of uncoordinated deployment. This includes GSM-R BS may be affected by intermodulation products generated from two or more signals coming from distinct 500mW NBN SRD transmitters.

RFID and 500mW networked SRD operating within 870-876 MHz or 915-921 MHz can be implemented under general authorisation with registration/notification or can be individually licensed to ensure appropriate protection of GSM-R when in the vicinity of rail tracks. RFID and 500mW networked SRD then need to be at fixed locations.

A possibility is seen to include provisions in the authorisation process for RFID and NBN SRD operating in the vicinity of rail tracks that define rules and enable adequate coordination in case of the occurrence of an interference case caused by e.g. intermodulation. The DAA mitigation technique for RFID does not resolve this situation.

It is recommended that such rules should be applied in case of experienced problems and not ex-ante, i.e. not before the occurrence of the problem; but rules should be clear and serve an immediate resolution of the local problem.

ANNEX 7: LIST OF REFERENCES

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- [3] Commission Decision 2013/752/EU amending Decision 2006/771/EC on harmonisation of the radio spectrum for use by short-range devices and repealing Decision 2005/928/EC
- [4] 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 (Radio Spectrum Decision)
- [5] ERC Recommendation 70-03: Relating to the use of Short Range Devices (SRD)
- [6] ECC Decision (04)06: The availability of frequency bands for the introduction of Wide Band Digital Land Mobile PMR/PAMR in the 400 MHz and 800/900 MHz bands
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- [27] ETSI TR 102 791: Technical characteristics of wireless aids for hearing impaired people operating in the VHF and UHF frequency range
- [28] ETSI TR 103 245: Technical characteristics and spectrum requirements of wideband SRDs with advanced spectrum sharing capability for operation in the UHF 870-876 MHz and 915-921 MHz frequency bands
- [29] ETSI TR 103 435: Technical characteristics for Ultra Narrow Band (UNB) SRDs operating in the UHF spectrum below 1 GHz
- [30] CEPT Report 44: Annual update of the technical annex of the Commission Decision on the technical harmonisation of radio spectrum for use by short range devices
- [31] ETSI Harmonised Standard EN 300 220: Short Range Devices (SRD) operating in the frequency range 25 MHz to 1 000 MHz
- [32] ETSI Harmonised Standard EN 303 204: Radio equipment to be used in the 870 MHz to 876 MHz frequency range with power levels ranging up to 500 mW
- [33] ETSI Harmonised Standard EN 300 422: Assistive Listening Devices including personal sound amplifiers and inductive systems

- [34] ETSI Harmonised Standard EN 302 208: Radio Frequency Identification Equipment operating in the band 865 MHz to 868 MHz with power levels up to 2 W and in the band 915 MHz to 921 MHz with power levels up to 4 W
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- [38] ECC Report 132: Light Licensing, Licence-Exempt and Commons
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