ECC Report 189

Future Spectrum Demand for Short Range Devices in the UHF Frequency Bands

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# Executive summary (style: heading 1)

Body text (style: ECC Paragraph)

(advice: the Executive Summary should provide a short and concise explanation on the purpose of the respective ECC Report and should clearly indicate the covered subjects to which it applies. In addition, it should clearly explain the application of the document.)

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**LIST OF ABBREVIATIONS**

|  |  |
| --- | --- |
| **Abbreviation****ALD** | **Explanation (style: Arial 10pt bold red (colour values RGB: 210, 35, 42)****Assistive Listing Device** |
| **CEPT** | European Conference of Postal and Telecommunications Administrations |
| **ECC****PA** | Electronic Communications CommitteePublic address System |
| **<abbr>** | <explanation – edit the table as necessary> |
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# Introduction

This report is intended describe the future spectrum demand for short range devices in the UHF frequency bands. The report is based on information and the spectrum requests, 870-876 MHz / 915-921 MHz, made in five separate ETSI Systems Reference Documents along with compatibility analysis of ECC Report 200. Consequently the scope of this report is limited to the frequency bands 870-876 MHz and 915-921 MHz only.

ECC Report 200 concluded that, under certain conditions, SRD could share with primary services and that intra-SRD sharing was possible. The report did however note that in several European administrations there remain existing government services and that there may need to be differing SRD parameters set in different national regulations.

This report suggests a set of technical parameters that may be taken forward in ERC Recommendation 70-03. It does this with reference to the principles set out in CEPT Report 44 which in itself was underpinned by ECC Report 181. As such, the suggestions within the conclusion of this report are as application neutral as possible while having the minimum necessary, but sufficient, technical parameters to ensure the efficient use of these frequency bands.

As ECC Report 200 clearly sets out, it will not be possible to have a simple harmonised set of regulation for SRD in the 870-876 MHz / 915-921 MHz band across Europe. As such there are likely to be different sets of apparatus made available for different markets within Europe. In the European Union, this situation is referred to “Class II apparatus”. That is to say that there will be restrictions on where particular apparatus can be lawfully operated. Manufacturers of apparatus operating in the 870-876 MHz / 915-921 MHz band will need to make it clear to users where apparatus may and may not be used.

Within this report there are any number of SRD specific applications that have been evaluated. The vast majority of these specific applications can be incorporated into a small set of generic or non-specific applications. There are however a couple of exceptions where there has been demonstrated sufficient justification to deviate from the preferred non-specific application designation. For example, in the 915-921 MHz band the distinctive operation of RFID interrogators requires a channelisation of the band and in the 870-876 MHz band the Network Relay Nodes may require some form of tailored authorisation mechanism.

The ECC Report 200 conclusions categorised the national sharing arrangements with primary services into four categories;

1. Countries where bands 870-876/915-921 MHz are used for TRR and/or UAS
2. Countries where the bands 873-876/918-921 MHz may be used for ER-GSM
3. Countries that deploy Wind Profiler Radars and other than above mentioned services in 870-876/915-921 MHz
4. Countries that do not presently use the bands 870-876/915-921 MHz

This report follows a similar methodology and the suggested SRD parameters are made with respect to any existing service within the bands. ECC Report 200 compatibility studies recognised the existing adjacent band services GSM and GSM-R. In all cases therefore, the parameters suggested by this report fully take account of those adjacent services.

The report takes a logical progression, firsts defining the request for spectrum access, then evaluating that request. The report identifies the limitations on gaining spectrum access across differing European administrations and finally the report makes suggestions that are intended to be taken forward in the ERC Recommendation 70-03.

# Definitions (optional section)

|  |  |
| --- | --- |
| **Term** | **Definition (style: Arial 10pt bold red (colour values RGB: 210, 35, 42)** |
| **<Term 1>l****Telecoil**  | <Definition 1>Audio Induction Loop systems, also called audio-frequency induction loops (AFILs) or hearing loops are an aid for the hard of hearing[[1]](#footnote-1) |
| **<Term 2>** | <Definition 2> |
|  |  |
|  |  |

# Objectives

Five Systems Reference Documents (SRDoc) were developed, each proposing a spectrum allocation for certain SRD and Low Power applications.

These five SRDoc,s contained eight application proposals;

* TR 102-649-2 Generic SRD, RFID, and Automotive SRD
* TR 102 886 Sub-metering / Smart Meters and Smart Grid
* TR 103 055 Metropolitan Mesh Machine Networks (M3N) applications.
* TR 103 056 Alarm and Social Alarm systems
* TR 102 791 Assistive Listening Devices

This chapter takes each of these eight groups of applications and discusses the motivation/benefit of each proposal in turn. A full explanation of each of the proposals is detailed in Annex 1.

### Generic SRD

ECC Report 182[[2]](#footnote-2) the Survey about the use of the frequency band 863-870 MHz noted that the use of generic SRD was likely to grow rapidly over the next 10-15 years. The objective of the ETSI proposal for generic SRD is to ensure sufficient channel access is available to allow generic SRD to continue to provide an acceptable QOS by having a sufficient number of channels available that allow a good chance that an intended message will be received.

Full details of the objective can be found in Annex 1.1.

### RFID

The objective for RFID to operate in the 915-921 MHz band is to improve the successful read rate of RFID tags. In this respect the move to the 900 MHz bands are twofold.

* There is near global harmonisation around 900 MHz for RFID logistics. E.g. In the USA the band 902-928 MHz is allocatred to RFID. As a consequence, RFID tags are typically manufactured to have their point of maximum response (their Q-factor) at or around the 900 MHz band. By interrogating the tag at its most responsive frequency, the signal received will be more robust and so a successful tag read becomes more likely.
* In the 915-921 MHz there presents 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 kHa and the power increased by 3dB over the RFID allocation at 865-868 MHz. This better defined RFID signal allows for greater penetration into pallets of goods and so a successful tag read becomes more likely.

These two benefits are both likely to improve the successful read rate of RFID tags.

Full details of the objective can be found in Annex 1.2.

### Sub Metering, Smart Meter

The proposals for Smart Metering have the objective of securing spectrum for a technology intended to deliver significant savings in generated energy. Smart Meters in Electricity consumption are intended to give users the information necessary to enable them to use energy more wisely. It is anticipated this will reduce the fluctuations in drawn energy and reduce the peak demand for consumption. This better balancing of the Electricity load could potentially reduce the need for the generation capacity to meet peak demand. Smart meters in Gas consumption would allow for the smarter distribution of the supply, where consumers could modify their consumption, particularly in periods of high demand.

Full details of the objective can be found in Annex 1.3.

### Smart Grid

The proposal for Smart Grid has the objective of enabling a robust end to end communication from household appliances through the Smart Meter to the generation network. The benefits of smart metering are enhanced by smart grid, as a further level of automation is added.

Full details of the objective can be found in Annex 1.4.

### M3N

A M3N is a network composed of the following of elements: Endpoints (Sensors and Actuators), Routers and Gateways. The proposal for M3N has the objective of gaining sufficient spectrum access to allow a multitude of endpoints and the in-network routers to operate within a combined mesh network. The present SRD allocation 863-870 MHz is segmented to Audio, RFID and telemetry radio systems. As such it does not present sufficient bandwidth for a distributed M3N.

Full details of the objective can be found in Annex 1.5.

### Surveillance Alarms, Fire/Smoke alarms,Intruder alarms, Social Alarms

The proposal for alarms sytems has the objective of securing a spectrum allocation for radio signals that need a predictable sharing environment to operate successfully. Alarm signals are infrequent but when called for, it is essential that the alarm signal is received. Radio alarm systems are becoming popular both where a wired system is impractical, such as in a historic building, but also as a low-cost solution in domestic premises.

Full details of the objective can be found in Annex 1.6.

### Automotive Active Safety, Automotive Diagnostic data exchange, Automotive Freight protection, Automotive Environmental & safety systems

Proposals for Automotive SRD largely have the same objective as the generic SRD objectives detailed in section 3.1.1. There are however exceptions where there are detailed the need for slightly higher power vehicle to vehicle communications. Such communications are not presently possible in the existing SRD allocations. In this case the objective is to allow communication between vehicles to allow vehicles to act cooperatively leading to both safety and environmental benefits.

Full details of the objective can be found in Annex 1.7.

### Assistive listening Devices

The proposal for Assistive Listening Devices has the objective of gaining spectrum access for the Telecoil Replacement System (TRS). The current Telecoil works well in small rooms where it is practical to install the audio inductive loop. However, this becomes impractical in large public places such as museums, rail terminus and airports. The TRS replaces the inductive system with a radio system operating in the far field. As such, it is able to be successfully deployed in wide areas.

Full details of the objective can be found in Annex 1.8.

# Assessment of the Request (incl. possible mitigation techniques, requirements)

In all cases of all five System Reference Documents, there is the request both for inclusion in the European Recommendation for SRD (ERC Rec 70-03) and for mandatory harmonisation within the EC, by inclusion in the EC Decision harmonising SRD use in the community 2006/771/EC.

 Annex 3 of this ECC Report indicates that a number of administrations may presently have a particular difficulty in agreeing to the use of SRD in these bands as envisaged by all the SRDoc. Therefore, it may be necessary to consider that certain mitigation techniques may be necessary to satisfy the requests. It may be necessary to include mandatory mitigation techniques in regulation, to ensure there is a reasonable opportunity for all the requested technologies to function successfully within the limited spectrum available and to allow sharing with the existing services noted by administrations. These pre-existing services may vary between administrations and so may the consequential SRD mitigation techniques.

**Overview of the request for spectrum**

The original vision for the frequency bands 870-976/915-921 MHz as defined in TR 102 649-2 is given in Figs. 1 and 2.

 .

1. **Summary of ETSI TRs outlining SRD tentative proposal in the band 870-876 MHz**

Within the 870-876 MHz band the exact spectrum allocation and associated technical parameters are not well defined in the TR 102 649-2. These parameters becaome apparent during the WGSE compatibility analysis WI 41 that lead to ECC Report 200.

Within the 915 to 921 MHz band the spectrum allocation was well defined in the TR 102 649. However this also evolved during the WGSE compatibility analysis WI 41 that lead to ECC Report 200.

Intra-SRD interference case studies: in general the prospects of intra-SRD co-existence appear to be moderately reasonably good with interference probabilities between 3-10% at comfortably low levels, even for very dense urban deployment scenarios and **without assuming band segmentation** or any special co-existence requirements except the intrinsic operational DC limits of studied SRD devices.

However, it may be seen that especially the lower powered applications, such as Non-specific SRDs or Home Automation/Sub-Metering devices with transmit powers on the order of 25 mW, might suffer interference from higher power SRD neighbours (typically around 100 mW). Therefore implementation of additional mitigation mechanisms would be helpful to drive the probability of interference towards zero.

### Generic SRD

As a result of their joint discussions, ETSI\_ERM TG28 and TG34 concluded that it would be desirable to separate the high power transmissions of RFID from the low power levels associated with SRDs. The present document therefore proposes that the band 870 MHz to 876 MHz is designated for use by SRDs at less than 100 mW and the band 915 MHz to 921 MHz is designated for high power devices such as RFID. As important requirement from the industry is that the new SRD bands should be an extension of the present SRD bands or close to them.

Users require improved functionality, features and performance. There is a demand for reliable performance proportionate to the application. Some applications require a very predictable sharing environment, some request even protection, e.g. safe harbour bands, priority applications, or to be treated as applications under the mobile service.

Many indicated that they can share spectrum provided that the exact minimum technical criteria for sharing are identified in spectrum compatibility studies.

Segmentation of the spectrum by defining specific frequency spots for specific applications should be avoided as much as possible, new frequency band segmentation or exclusivity for specific applications cannot be the common target. We need to take into account the lessons learned from 863-870 MHz (see questionnaire) and generate a broad regulation. Application terms are not sharply defined. Application convergence / application innovation is also to some extent blocked by application segmentation.

For technical reasons it is proposed to divide the band into a limited number of sub-bands to cover:

• SRDs using duty cycle up to 1 % or LBT with AFA (or equivalent techniques).

• SRDs that transmit intermittent very short bursts of power and rely on duty cycle for mitigation.

• SRDS covering a number of services and functions with similar behaviour, technical parameters and mitigation techniques that would provide a more predictable sharing environment as requested by the European Commission.

A non-exhaustive list of applications for SRDs using either duty cycle or LBT + AFA (or equivalent techniques) is provided below, based on information in A.2 of the ETSI TR 102 649-2:

Home and Building automation (some examples):

* Lighting control;
* Shutter, awnings and blinds control;
* Windows, doors and gates openers control, garage doors, electrical door lock systems;
* Heating, ventilation regulation and air condition control;
* Swimming pool surveillance and control;
* Combined scenarios;
* Sensors (temperature, wind, light, rain);
* Presence monitoring;

Telemetry and telecommand (some examples):

* Pumping station monitoring;
* Electricity network monitoring;
* Crane and machinery control;

Mixed speech and data (some examples):

* Wireless door entry;
* Alarm ambiance background scanning;
* Baby and elderly monitoring;

Access control (some examples):

* Disabled persons access;
* Security applications;

Machine to Machine (some examples):

* Remote data collection (state of machines);
* Remote control (management);
* Remote payment;
* Remote restaurant/bar customer orders data collection;
* Portable Bar Code Scanner;

Aviation and Maritime applications (some examples):

* Remote data maintenance collection (service information of aircraft downloaded while taxiing).

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|  | **Type of Predictable Sharing Environment** |
| **Technology proposal** | **Low Cost** | **High Reliability / Low latency** | **High Speed Data** | **Higher Power Set Bandwidth** |
| Generic SRD | Yes | Partly, for some applications | Not defined | 870-876 MHz: 25 mWDC up to 1%, DAAAPCMaximum occupied bandwidth: 600 kHz |

* The vast majority of these applications are either fixed installed applications, nomadic use applications or used at very specific locations (e.g. aircraft taxiing). There are practically no fully mobile non-specific SRD applications provided in ETSI TR 102 649-2 under the generic SRD proposal. Only some (not all) automotive applications indicate fully mobile use.
* The ETSI proposal in TR 102 649-2 is focussing on the frequency range 870-873 MHs for generic SRD but leaves the upper limit subject to change depending on the outcome of the spectrum engineering studies
* Higher emission limits than 25 mW may be combined with lower emissions over time / duty cycle. The following combinations are under study:

|  |  |
| --- | --- |
| 1 mW | 5% |
| 25 mW | 1% |
| 100 mW | 0.1% |

* The use of APC and DAA may improve the coexistence situation.
* Spectrum fragmentation should be avoided and much as possible.
* Cost considerations may lead for generic SRD to limited receiver performance capabilities which are interlinked with a limited range of power capabilities. A minimum receiver performance may be needed to be standardised.
* The proposal for specific SRDs with the same power level of 25 mW is using the same duty cycle limit of 1% and may only differ in terms of deployment numbers and the assumed usage densities.
* Many specific SRD applications for which the ETSI TR 102 649-2 is focussing on the frequency range 873-876 MHz are encompassed in the envelope parameters as indicated above:
* Metering: 25 mW, channel BW of 200 kHz, DC up to 1%;
* Alarms: 25 mW, channel BW of 200 kHz, DC up to 1%;
* Portable Alarms (for personal security): 100 mW, channel BW of 25 kHz, DC up to 0.1%;
* Automotive Devices[[3]](#footnote-3): 100 mW and more, channel BW up to 500 kHz, DC up to 0.1% (transmit power and DC are inter-linked as shown in Table 2).
* The minimum requirement indicated for the main specific SRD sectors above is to have a minimum for 2 MHz of usable spectrum;
* Some automotive, smart metering and M3N applications indicate the need for higher emissions than 100 mW with up to 500 mW.
* There is also demand for an FHSS usage case option.

### RFID

As a result of their joint discussions, ETSI\_ERM TG28 and TG34 concluded that it would be desirable to separate the high power transmissions of RFID from the low power levels associated with SRDs. The present document therefore proposes that the band 870 MHz to 876 MHz is designated for use by SRDs at less than 500 mW, with low Duty Cycle. The band 915 MHz to 921 MHz is designated for high power devices such as RFID.

To satisfy the perceived future market requirements for RFID, it is proposed that interrogators will operate in the band 915 MHz to 921 MHz at power levels of up to 4 W e.r.p. in four channels of 400 kHz each. The remainder of the band will be used for the low level response from the tags. This will increase reading performance and potentially permit data rates that are four times faster than those currently possible.

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1. **Summary Of ETSI TRs Outlining SRD/RFID Requirements In The Band 915-921 MHz**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Frequency bands** | **Power** | **Duty cycle** | **Channel bandwidth** | **Notes** |
| Interrogators:915 MHz to 921 MHzInterrogator centre frequencies916,5 MHz917,7 MHz918,9 MHz920,1 MHz |  4 W e.r.p. on a single interrogator channel for each individual interrogator | No mandatory limit for transmitter on-time. However interrogators will not be allowed to transmit longer than it is necessary to perform the intended operation | fc ± 200 kHz | Interrogators may operate in any of the four high power channels |
| **Tags:**Between 915 MHzto 921 MHz | < -10 dBme.r.p. per tag |  | fc ± 1 000 kHz for tag response |  |
| **SRDs:**915 MHz to 921 MHzCenter frequencies for high power SRD channels916,5 MHz917,7 MHz918,9 MHz920.1 MHz |  0,1 W e.r.p. in RFID high power channels | 0,1 % duty cycle or LBT + AFA | fc ± 200 kHz | Transmit levels outside of high power channels will not be allowed to exceed 25 mWe.r.p. |
| NOTE: fc are the carrier frequencies of the interrogators. SRD receivers should be category 2or better as specified in EN 300 220  To minimize the risk of interference from RFID, SRDs may use LBT with AFA or equivalent techniques in the high power channels. Suitable separation distances should be studied. To minimize the risk of interference from SRDs to RFID tag responses, SRDs should use LBT with AFA or equivalent techniques in the remaining 2,2MHz. Suitable separation distances should be studied. |

### Sub-Metering, Smart Meter

For smart metering / smart grid there is a proposal by ETSI, to use approximately 1 MHz in the frequency range of 870-876 MHz with up to 25 mW output power. The focus of the use should be to see this in the in-house domain. An exclusive use of the frequency range by smart metering / smart grid is not foreseen. Furthermore, it is planned to govern also this use in the future in the context of a general allocation.

It must be distinguished:

a. the wireless consumption reading

b. b. automatic adjustment of consumption

(In particular, a) and (b)) seem to be, since it's a few bytes/h, hardly critical applications, for the most part of indoor, 10-20 meters to be an SRD theme.

Dedicated terms of use appear useful, to this SRD to decouple from other SRD applications (e.g. to avoid co-frequent use with continuous transmissions).(if any LDC regime or a certain medium access regulation, which excludes for example continuous or transmissions with high activity).

The TR 102 886 makes precise request for a spectrum allocation for Smart Meters in the band 873 MHz to 876 MHz:

• a duty cycle of 2,5 % with no limit applied in any period;

• a power limit of not less than 100 mWe.r.p. (500 mWe.r.p. assumed);

• the channelization scheme proposed for SRD devices to correspond to the E-GSM-R scheme.

Smart metering:

 Bandwidth: Low, from 10 to 30 kbps;

 Latency: very diverse ranges cited, depending on technology, from >1 second for distribution automation operations up to 24 hours;

 Availability: Range from 95% to 99.999%;

 Security: overwhelmingly high support;

 Coverage: Range from <95% of nationwide population to 99% of territory covering suburban and urban areas or100% population.

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|  | **Type of Predictable Sharing Environment** |
| **Technology proposal** | **Low Cost** | **High Reliability / Low latency** | **High Speed Data** | **Higher Power Set Bandwidth****Usage density** |
| Sub-Metering, Smart Meter | YES | No15 min transmission update | NoUp to 100 kbps (instantaneous BW) | 873-876 MHz25 mW, 0.1% DC100-500mW, up to 2.5% (specific DC)% for some applications and using max Tx on restrictions4x200-250 kHzUp to 25,000 / km2 in urban centres |

### Smart Grid

Communications / data transfer

The respondents to a questionnaire from the EC [ref] had a variety of views concerning the specific communications / data transfer related requirements for the "mission-critical" applications; some examples are shown below:

a. The suggested minimum time for resiliency, or power supply independency, ranged from 8-12 hours (depending on services) up to 72 hours (for the most critical services and sites);

b. The maximum allowed delay, or latency, suggested for the most critical (high voltage teleprotection) services varied from 3 ms to 10 ms, or to 'low-double-digit' milliseconds, and for other high priority services the variation was in general between 50 ms and 100 ms, some indicating the maximum delay for certain mission-critical applications to be even up to 1 second;

c. The availability of the services should be better than 99.9% for any mission-critical service according to some of the respondents, while some indicated 99% availability to be sufficient. For the most critical services, the required level of availability was seen to be between 99.5% (some indicated only one value for all mission-critical services) and 99.999%;

d. The bandwidth / data rate requirements for mission-critical applications were in general seen to be up to around few Mbps (megabits per second), ranging from some hundreds of kbps (kilobits/s) to 100 Mbps; however in the latter value the possible future needs for data concentration / aggregation points had already been considered.

Utilities indicate that they should be able to operate their own infrastructure for mission critical services, or at least request dedicated networks for part or overall smart grid systems, as resilient uniform nationwide coverage with a guaranteed quality of service (QoS) cannot be provided by commercial telecommunication networks, which are also not regarded as able to handle safely the mission-critical data. Even though certain commercial solutions are technically compliant, some utility companies do not want to rely on commercial operators due to the lack of level of control; these utilities are of the opinion that such solutions do not offer a complete end-to-end control or guaranteed QoS, and that the promised power autonomy, redundancy and availability can be insufficient.

Telecom operators and some equipment manufacturers state that existing commercial telecommunication networks can deliver discrete or end-to-end solutions over shared or dedicated infrastructure meeting the negotiated Service Level Agreements (SLAs) on the required performances for the smart grid communication needs.

Regarding the question on the ownership and control of the communication networks, the respondents in general either indicated that there is no definitive answer applicable to all situations and that the answer depends on a number of factors. A number of respondents were in the opinion that the ownership of communication infrastructure is not necessary and that shared infrastructure will typically be the most cost-optimised solution, while some stated that infrastructure fully owned and controlled by utilities would be required to handle mission critical services.

On the synergies between utilities companies and telecom operators, in general infrastructure (e.g. radio sites and masts, backhaul capacity, dark fibre, cable ducts and tunnels, utility poles) sharing is seen to improve cost-effectiveness and the use of existing resources as well as to extend geographical coverage. However, some respondents note that infrastructure sharing is also an issue subject to national regulations and circumstances, and the question remains how to deal with the limits of responsibility, commercial issues and competition. Some utilities indicate that shared infrastructure can be an option when the utility has a sufficient level of control over the solution.

 Reliability: Range between 10 and 72 hours.

|  |  |
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|  | **Type of Predictable Sharing Environment** |
| **Technology proposal** | **Low Cost** | **High Reliability / Low latency** | **High Speed Data** | **Higher Power Set Bandwidth** |
| Smart Grid | Yes | YES99 % to 99.995%100% coverage6-1000 ms latency | kbps to few Mbps | Depending on technical solution |

### M3N

The proposal investigates the use of M3N in the UHF Band.

• 0,1 % duty cycle is very low for M3N operation.

• Co-existence with permanently transmitting high powered RFID equipment will harm M3N reliability and battery lifetime.

• The distance between M3N devices in some deployments may be greater than the radio range achievable with 25 mW EIRP.

• M3N application may require data rates up to 100 kbps.

• Human acceptable / IP acceptable latency.

• A 25 ms transmit time limitation (Ton) is too short to comply with MAC mechanism needed by battery powered devices to prevent idle listening.

• A 200 kHz channelization scheme (sub-divisible into 100 kHz or 50 kHz) consistent with E-GSM-R (between 873 MHz and 876 MHz), is required for spectrum efficiency and coexistence with Smart Metering.

Therefore, the M3N requirements in the band 870 to 876 MHz are;

Parameter Value

Power 100 mW EIRP

Channelization 200 kHz (with 50 kHz and 100 kHz sub channel)

Duty Cycle Overall 1,25 % measured over a specified interval without peak limit in any sub interval,†, when required for coexistence with existing services

Overall 1 % measured over a specified interval without peak limit in any sub-interval and without transmit time limitation† (outside 873 MHz to 876 MHz band to avoid coexistence issue with E-GSM-R)

Bandwidth As Smart Metering is a part of M3N, requirement identified in 102 MHz to 886 MHz between 873 MHz to 876 MHz band, in co-existence with E-GSM-R

800 kHz outside E-GSM-R band for M3N devices requiring transmit time longer than 25 ms, situated as close as possible of the 873 MHz to 876 MHz Band (Subject to the outcome of compatibility studies.)

The TR 103 055 makes precise request for a spectrum allocation for Smart Metering and Mesh Metropolitan Machine Network in the band 873 MHz to 876 MHz:

• a duty cycle of 1,25 %;

• a power limit of not less than 100 mW EIRP (500 mWe.r.p. assumed);

• the 200 kHz channelization scheme proposed for SRD devices to correspond to the E-GSM-R scheme.

In addition there is a further request for a frequency band of 800 kHz immediately below 873 MHz for high performance UHF SRD systems for Smart Metering and Mesh Metropolitan Machine Network.

• a duty cycle of 1 % without transmit time limitation;

• a power limit of not less than 100 mW EIRP (to be compatible with other co-channel SRD);

200 kHz channelization, sub-divisible in 100 kHz or 50 kHz channel.sss

|  |  |
| --- | --- |
|  | **Type of Predictable Sharing Environment** |
| **Technology proposal** | **Low Cost** | **High Reliability / Low latency** | **High Speed Data** | **Higher Power Set Bandwidth** |
| M3N | Yes | No | Up to 100 kbps | 100-500 mW range1.25 % DC (25 ms max single TX on)200 kHz channelization, sub-divisible in 100 kHz or 50 kHz channel |

### Surveillance Alarms, Fire/Smoke alarms,Intruder alarms, Social Alarms,

The TR 103 056 makes request for a dedicated spectrum allocation for Alarms in the band 875.6 – 876MHz. The technical parameters are:

25 mWe.r.p.

Band edges in compliant to GSM-R channel plan.

 Indicative DC:

* Max Transmitter On Time / per single transmission: [700ms]
* Min Transmitter Off Time between two transmissions: [400ms]
* Sum of Ton times / minute = DC/min [2.5]%/min
* Sum of Ton times / hour = DC/hr: [0,1]%/hr

The DC / LDC requirement to be defined during compatibility analysis

The TR103 056 also requests shared spectrum in the bands 915 – 915.2MHz and 920.8 – 921.0MHz. The technical parameters are;

25 mWe.r.p.

The DC / LDC requirement to be defined during compatibility analysis

Band edges in compliant to GSM-R channel plan.

|  |  |
| --- | --- |
|  | **Type of Predictable Sharing Environment** |
| **Technology proposal** | **Low Cost** | **High Reliability / Low latency** | **High Speed Data** | **Higher Power Set Bandwidth** |
| Alarms | Yes | Yes | In general No. | 25 mWDC, LDC |

### Automotive Active Safety, Automotive Diagnostic data exchange, Automotive Freight protection, Automotive Environmental & safety systems

|  |  |
| --- | --- |
|  | **Type of Predictable Sharing Environment** |
| **Technology proposal** | **Low Cost** | **High Reliability / Low latency** | **High Speed Data** | **Higher Power Set Bandwidth** |
| Automotive | Yes | Yes | 1 to 100 kbpsOr 600kchips/s (DSSS) | 25 kHz up to 1.2 MHzDC .1% to 1%25 mW to to 500 mW873-876 MHz |

### Assistive Listening devices

Assessment of the Request (incl. possible mitigation techniques, requirements

TRS is a new digital ALD system which incorporates a range of spectrum efficient technologies compared with the current 100% duty cycle FM devices::

* Up to 600kHz channel bandwidth (20dB -bandwidth) (narrower bandwidth possible by using low data rate)
* 500kbit/s modulated data rate, using, e.g., 4GFSK modulation
* 10mW transmitter ERP for typical cases
* 25% transmitter duty cycle or frequency hopping, no LBT
* Systen can use fixed frequencies or frequency hopping
* Minimum of Six channels
* Capable of spectrum sensing

In addition the fixed “base” transmitters can have the transmit spectrum remotely controlled from a database or a local control (ie Airport frequency manager)

As TRS are designed as a worldwide “public” system common spectrum is required to maximize their effectiveness,. Investigation of currently available spectrum including all current SRD bands has failed to find spectrum for these low latency systems which require a very low level of potential interference(loud noises in the ear canal are both frightening and dangerous) and has generated the request within TR 102-791for additional spectrum access

### Mitigation Techniques

The system is capable of frequency hopping, remote control via a database or local control with a duty cycle dependant on band width and spectrum sensing. These techniques either separately or in combination provide mitigation for a wide range of circumstances.

Sharing: from work carried out in WI 41 the TRS can share with high power RFID based on the premise that these systems are unlikely to be physically in the same geographical location at the same time and place

# Specific Benefits of harmonization

Make category specific benefits clear Sections 5.1, 5.2, 5.3, 5.5 and 5.6 all need expanding to state the actual benefits of harmonisation

## 5.1 Generic SRD

For generic SRD the benefits of further European harmonisation are discussed in paragraph 0.6.2 of the Report into the “Study on the Legal, Economic & Technical Aspects of Collective Use of Spectrum (CUS) in the European Community ”. This report concludes that the benefits of harmonisation are “substantial”.

## 5.2 RFID

For 900 MHz RFID the benefits of harmonisation with the USA allow for greater probability of successfully reading a tag. Tags have a natural resonance (Q-factor) which is determined in manufacture. By sharing a common frequency with the USA, tags can be read nearer their point of maximum response amplitude. Harmonisation within Europe of RFID tags is essential to allow for the benefits in cross border trade in RFID tagged products. Harmonisation both throughout Europe and the USA will increase these benefits further.

## 5.3 Sub-Metering, Smart Meter

Smart Meterinstallations tend to be fixed. Therefore the technical reasons for harmonisation are less clear than for mobile SRD. However the economic benefits of scale detailed in the CUS Report are once again substantial.

## 5.4 Smart Grid

Smart Meters installation tend to be fixed. Therefore the technical reasons for harmonisation are less clear than for mobile SRD. However the economic benefits of scale detailed in the CUS Report are once again substantial.

The views on the existence of barriers that would impede co-investment are mixed. National administrations and telecom operators do not see any barriers that would hinder co-investment between utilities and telecom sectors. Utilities noted that the telecommunication legislation was fragmented in several Member States, causing restrictions, legal barriers or different approaches to cooperation between utilities and telecoms. Infrastructure companies' responses were more diverse; some indicate that national regulations could hinder co-investment, while others note that the lack of a dedicated spectrum for smart grid purposes could be inhibiting co-investment.

The vast majority of respondents to the EC call [ref] supported the need for interoperability of various smart energy grid related areas or services. Responses cite Various reasons for supporting the need for interoperability were given, including the creation of economies of scale and cost reduction, reduction in the risk of cross-border interference, and greater flexibility.

Several infrastructure providers cite smart grid applications as being an area that could benefit from harmonisation of shared spectrum at EU level. Examples of spectrum uses that could be a good partner for sharing include smart connections, smart grid equipment, electric vehicles, public safety users, commercial networks, PPDR (public safety and disaster relief), railway networks, M2M style applications that share common application characteristics, spectrum used for IP-based communication, and short-range communication. Reasons for the sharing of spectrum include to ensure economies-of-scale of smart grid equipment due to manufacturers and developers having access to the entire EU market, the encouragement of competition, development of products for the whole EU market resulting in lower prices paid by utilities, and potentially lower spectrum acquisition costs. Other respondents are of the view that spectrum should not be shared and do not provide any services that they feel could be shared.

A majority of respondents provide examples of economic, social and environmental impacts resulting from the shared use of spectrum for smart grid and smart meter applications, most of which are positive to varying degrees.

Utilities cite faster implementation of technologies as an environmental benefit, a reduction of costs in smart meters due to the amortisation of development costs in the long-term, a reduction in cost due to increased competition for the utility sector, and better economic and environmental impacts due to reduced deployment and operating costs.

Infrastructure providers referencing smart grid applications cite a larger harmonised market for vendors, leading to lower costs to utilities and thus to consumers. Radio pollution or radio smog could be reduced, thus reducing environmental impacts. Regarding smart meters, infrastructure providers note potential enlargement of the European market for smart and green appliances, and impacts due to an increase in consumer awareness of consumption and energy efficiency.

## 5.5 M3N

M3N installations tend to be fixed. Therefore the technical reasons for harmonisation are less clear than for mobile SRD. However, there are clear benefits in an economy of scale in the supply of products.

## 5.6 Surveillance Alarms, Fire/Smoke alarms,Intruder alarms, Social Alarms,

Alarm installations tend to be fixed. Therefore the technical reasons for harmonisation are less clear than for mobile SRD. However, there are clear benefits in an economy of scale in the supply of products.

## 5.7 Automotive Active Safety, Automotive Diagnostic data exchange, Automotive Freight protection, Automotive Environmental & safety systems

For Automotive applications of, Freight protection, Environmental & safety systems, Remote key entry / keyless entry, In-car remote operation, Comfort systems outside the vehicle and Infotainment fitted to vehicles, there is a clear need for harmonisation, given the mobility of vehicles.

The increasing requirements for road-safety services which are often politically mandated increases the general spectrum requirement and in particular frequency bands with a more predictable sharing environment.

For road-safety related SRD applications here is also a need to consider a new approach for some applications requiring a higher level of protection with a more predictable sharing environment as outlined in CEPT Report 44.

Unlike home automation, smart grids and smart metering applications, automotive SRD applications are not fixedly installed. Vehicles can go across boarders and this has to be taken into account, should the spectrum in 870-876 MHz / 915 -921 MHz is not available for SRD applications on a fully harmonised European basis.

## 5.8 Assistive Listening Devices,

TRS is proposed as a public system for worldwide use for those with hearing impairment, due to the small physical size of the personal units a single receiver is necessary with no user intervention for channel changing.

# Most suitable frequency option

Add text from University of Dortmund studies, to stress that frequencies below 1 GHz are better options

The principles set out in ECC Report 181 “Improving spectrum efficiency in SRD bands”, have been taken forward in the development of the most suitable frequency options for the 870-876 MHz and 915-921 MHz bands. In particular the conclusion that SRD Access Mechanisms are based on sound technical foundations, rather than simply dividing spectrum by application type.

## 6.1 Generic SRD

The frequency band 870 MHz to 876 MHz and its duplex pairing 915 MHz to 921 MHz was the subject of a CEPT review in September 2008. A summary of the re-assignment plans for these frequency bands in the major markets identified in annex F is shown in annex A. The output of this review revealed that this duplex pairing was allocated for digital land mobile applications in accordance with ERC/Dec(96)04 [i.6] and ECC/Dec(04)06 [i.7] and for military use. The common use of this duplex pair within Europe is for tactical military relays.

In the lower and upper band most administrations were of the view that some sharing of part of the band would be possible following co-existence analysis and only if existing services could be protected.

In advance of any harmonised approach to the use of this band the German regulator has to issue a licence to the Deutsche Bahn to operate GSM-R in the band 873 MHz to 876 MHz. OFCOM in the UK recently completed a consultation where it invited interested parties to comment on potential uses and licensing schemes for the frequency band 872 MHz to 876 MHz and the complementary duplex frequencies. At the time of writing this document the final results of this consultation are imminent.

Spectrum options should be considered in this most precious part of the UHF band. There is a clear need to evaluate the options with regard to the impact, since a final decision for new spectrum is likely to be irreversible. Improvements to achieve more efficient use in 863-870 MHz have also to be considered. 870-876/915-921 MHz proposed by ETSI.

## 6.2 RFID

Other proposals noted: whitespace/geolocation in 470-790 MHz for apps such as RFID and other high-end SRD, 821-832 MHz duplex gap. Higher frequencies may also need to be discussed.

Operation by RFID in the proposed band 915 – 921 MHz will provide the following important benefits:

* **Harmonised frequency band.** RFID is a global business with more and more tagged items increasingly moving between the three ITU Regions. Outside Europe, the majority of the world’s trading nations operate RFID at UHF within the frequency range 902 – 928 MHz. This ensures that the performance of RFID is consistent across these countries, which is of big benefit for users. Already tags have been optimized for operation in the band 902 - 928 MHz. This development has simplified the international movement of goods – particularly for those items that are tagged at source. However it has left Europe in a position where the performance of RFID is inferior to what is being achieved in the rest of the world. Also the need to manufacture non-standard equipment for use in Europe is likely to lead to higher equipment costs. To ensure that RFID in Europe can compete on an equal basis, it will be important to designate global parameters for operating frequencies, power levels and spectrum masks.
* **Higher data rates.** Increased bandwidth will permit RFID in Europe to operate at the maximum data rate specified in the ISO standard 18000-6. This will have two important benefits. Firstly it will enable RFID interrogators to read faster moving tagged items as they pass monitoring points, which will allow the use of RFID on processes that have a requirement to track fast moving items. Secondly there is often a need to increase the number of tagged items on pallets while maintaining existing handling times. Higher data rates will make this possible.
* **Higher transmitted power.** Increased power levels will give the obvious advantage that some applications will be capable of operating at greater ranges. This is particular beneficial in certain logistics applications. However there is another less obvious benefit. Typically the reading performance for tagged cases on pallets is of the order of 98 – 99%. The reason for the missing 1 or 2 % of tags is due to them being positioned in the centre of the pallet where signal levels are much reduced. Higher power levels will permit these tags to be read. The consequent reduction in effort in handling such discrepancies will represent a substantial saving.
* **Simplified installation.** With the continued growth of RFID, it is inevitable that some users will wish to operate interrogators that are physically close together. This is particularly likely to apply to certain industrial and materials handling applications. However due to inter-modulation products, a minimum separation is required between interrogators operating on the same or adjacent channels. This can prevent interrogators from being positioned in optimum locations. The availability of additional channels with increased channel spacing will largely overcome this limitation.
* **Frequency diversity**. In applications where it is necessary to read stationary tagged items, this can lead to problems due to standing wave nulls. Such situations can arise in certain production and inventory applications. The use of frequency diversity can substantially eliminates such problems. Interrogators would be designed to switch their frequency of operation between the bands 865 – 868 MHz and 915 – 921 MHz.
* **Ranging** The ability to change the frequency of transmission of interrogators between the two RFID bands will make it possible to perform ranging. This will allow the position of tags to be determined. An example of where ranging can be of particular benefit is at the exit of a shop, which is fitted with a combined RFID/EAS system. The system would detect the position of suspect tags that are within the zone of the shop exit. A further important benefit of ranging is that it reduces the problems associated with unwanted reflections.

## 6.3 Sub-Metering, Smart Meter

The use of the frequency range 169,4-169,8125 MHz is in the process of being revised and will be available for smart metering / smart grids. The possible use of the about 400 kHz for smart metering / smart grid in this frequency range can be considered only as a supplement, but is well suited because of the ideal propagation conditions to read meters in cellars.

The topic of smart metering / smart grid is very complex and must be divided into different areas. It is in principle to distinguish between reading meters for electricity, but also gas, heat and water (metering), control of energy networks and the integration of intelligent electric appliances. This caused various interfaces and several ways of data transmission. Trunked radio and mobile networks to wireless, nationwide read meters suitable within the existing terms and conditions and individual allocations. The integration of renewable power generators and also intelligent electricity into the power grid could be realized with radio equipment of short range on the basis of a general allocation. For purely in-house applications (smart home) already existing radio applications (WLAN, ZigBee) are generally available.

Sub-GHz bands between 400-500 MHz or 800-1000 MHz are the most cited in the discussions for wireless metering technologies, offering a combination of large coverage area and low bit rates with smaller coverage distance and higher bit rates.

The results of detailed investigations performed [ref Uni Dortmund as was commissioned by the German Ministry of Economics] also confirm this view due to the propagation characteristics above 1 GHz limit drastically the possibility to reach all the endpoint / metering sensors in a network (often inside, or even in basements).

## 6.4 Smart Grid

Electricity generation from renewable and conventional energy, the efficient and reliable distribution of electrical energy are requiring solutions for decentralised small producers of electricity and operators of the electricity transport networks. Communication channels are required, which can be realised also wirelessly to some extent.

For this purpose, in particular to smart grids, there are already a number of frequency options available or under discussion to meet the requirements of intelligent electricity networks.

Frequency options:

For the realization of wireless communications for smart smart grids are predominantly frequency bands below 1 GHz best suited.

- 450 MHz (PMR/PAMR)

- Mobile networks (PMR/PAMR elsewhere)

- Public networks (wireless access)

- 870-876 MHz (extension for SRD - applications, ETSI proposal)

Under frequency-regulatory aspects it is also decisive how far realisations are possible within the framework of the existing Regulation (individual allocations, General allocations). Also, some still pending requests outside of radio frequency regulation can affect the future spectrum requirements (security-related requirements, data protection, etc.).

Utilities generally favour using different technologies depending on technical and operational capabilities as well as strategy. Currently, only GSM/GPRS (at 900 MHz) and CDMA (at 450 MHz) can be considered. In the long term, other technologies such as UMTS, HSPA, LTE or RF meshed network solutions may also be considered. Other stakeholders generally supported the use of GSM and 4G/LTE technology in the short/long term respectively, but also included other technologies including EVDO, PMR(TETRA), WAN or Smart Utility Network (IEEE 802.15.4g) and future WiFi (IEEE 802.11ah) associated to mesh routing protocol for shorter ranges.

National administrations and utilities overwhelmingly believe PMR networks could be implemented on a shared basis, but caution different requirements by public users and situations when utilities and 'blue light' services would want priority network access at the same time. Infrastructure providers' and telecom operators' responses were more varied. Some believe that current telecommunications networks are suitable and sufficient; others agree with PMR sharing but caution the challenges it would require, and some feel it must be a dedicated spectrum and should not be shared.

Utilities responses to the use of mission-critical services on a shared PMR network vary. Some are of the opinion that not all 'mission-critical' communications can be met by wireless technologies, while others feel that a shared network could work if Service Level Agreements are such that using a shared network is transparent for the utility. A couple of responses also favour the use of shared PMR as a back-up system during emergency situations. Responses from infrastructure manufacturers do not eliminate the possibility of using 'mission-critical' services on a shared PMR network, but cite various challenges (e.g. high costs, equipment compatibility, resilience, End Point Design complexity, built-in network management) as reasons for choosing other possibilities.

Sub-GHz bands between 400-500 MHz or 800-1000MHz are also the most cited in the EC call [ref] for long and short range wireless technologies, offering a combination of large coverage area and low bit rates with smaller coverage distance and higher bit rates.

The results of detailed investigations performed by the university of Dortmund [ref] also confirm this view due to the propagation characteristics above 1 GHz limit drastically the possibility to reach all the endpoint / sensors in a network.

## 6.5 M3N

Comparison between M3N estimated traffic, and electric smart metering requirement show that a M3N network, aggregating every envisioned smart city applications can operate with similar EIRP and duty cycle constraint.

The preferred allocation needs a power of 100 mW, 1% duty cycle and a channelization of 200 kHz.

## 6.6 Surveillance Alarms, Fire/Smoke alarms,Intruder alarms, Social Alarms,

The preferred future frequency allocation is in the upper part of the 870 to 876 MHz (see figure 1) because these applications may very likely coexist with GSM-R due to

low activity factor and

low duty cycle and with

c. short telegram bursts only in the case of an alert

A second allocation may be in the band 915 – 921 MHz.

The existing frequency allocation in the 868 MHz band (ERC Rec 70-03, Annex 7) should be kept due to an installed basis of billions of devices and systems in CEPT countries. Otherwise the performance, reliability and functionality may decrease significantly due to competition with other applications in the same band which generates a non predicting base load.

## 6.7 Automotive Active Safety, Automotive Diagnostic data exchange, Automotive Freight protection, Automotive Environmental & safety systems

Access to new spectrum within the band 870 MHz to 876 MHz provides the potential for a long term solution for automotive Short Range Devices.

The majority of automotive SRD can be accommodated within the non-specific SRD allocations, as depicted in ERC Rec 70-03 Annex 1. There are however requests for specific higher power (500 mW) automotive applications, relating only to TTT use as depicted in ERC Rec 70-03 Annex 5.

These automotive SRD are distinct from automotive ITS applications. They are more narrowband than ITS and have different transmission characteristics to ITS which is more like a wideband data transmission. It is therefore not appropriate, within the principles set out in ECC Report 181, to allocate these automotive applications with the spectrum already allocated to ITS.

## 6.8 Assistive Listening Devices

ALD represent a niche deployment of SRD, albeit an SRD vital to the hearing impaired. In developing the sharing studies in ECC Report 200, it became clear that the relatively high duty cycle requirement necessary in ALD, made it difficult to share with many SRD applications. However, being a niche deployment, there were identified sharing opportunities due to distance separation with other SRD that are unlikely to be deployed ubiquitously. The clear option for co-channel allocation is RFID interrogators. It is extremely unlikely that RFID and ALD will be co-located. As such, the most suitable frequency option for ALD appears to be co-channel with RFID interrogators.

# Existing Nationalspectrum use in the 870-876 MHz and 915-921 MHz bands

* 1. **Governmental use in 870-876 MHz and 915-921 MHz**

**7.1.1 Tactical applications**

There are several definitions for tactical radio but the main property for tactical radio in the discussed frequency bands is that these tactical radio applications may be deployed without notice in a particular geographical location when needed. The absolute link budgets for these applications are unknown but are usually chosen within borders for a reliable operation with a 99,5 % confidence.

Tactical applications are designed to cope with intentional interferers such as jammers but only in a single entry case. Most applications expect an average deployment of interferers or collocated applications near zero to guarantee their confidence level.

To illustrate the typical use we use three different example scenarios

**1 bomb disposal robot:** The moment for its use is unplanned and also the location of deployment may be very diverse. Examples are an office environment, supermarket, school, apartment block, roadside, industrial location. All typical locations were RFID and / or other SRD use is depicted. The covered area itself is small so single interferers are the main source of interference, variations in the link budget for the wanted signal are usually a constant factor. Sharing with licence exempt applications is not considered possible. Typical average use in The Netherlands is 5 deployments / day

**2 tactical team helmet camera and radio link:** The moment for its use may be planned or unplanned. The covered area is medium and the main source of interference is both the single interferer and the aggregate in a 50x50m square. The link budget has a strong location dependency but has a statistical confidence. When deployed in buildings the average link budget goes down. Sharing with licence exempt applications is not considered possible for indoor scenarios.

**3 unmanned aerial vehicle:** The moment for its use may be planned or unplanned. The covered area is large and the main source of interference is the aggregate. The armed forces are the only organisation in The Netherlands to operate above city areas and use the vehicles non line of sight. Link budgets are variable from high to very low. Sharing with licence exempt applications may be theoretically possible after a careful compatibility study but unlikely to be approved.

See Annex 3 for Replies to CEPT Questionnaire on the use in 870-876 MHz and 915-921 MHz

# Technology Standards

* 1. Equipment Standards under development in ETSITG17, TG28 and TG34 in support of SRD allocations 870-876 MHz and 915-921 MHz.

|  |  |  |
| --- | --- | --- |
| ETSI ERM sub-group | Title of Standard | Comments  |
| ETSI ERM TG17 | Revision of EN300 220TS Smart MetersEN 303 131 |  |
|  |  |
| ETSI ERM TG28 |  |  |
|  |  |
| ETSI ERM TG34 |  |  |
|  |  |

Table 1. List of SRD Standards under development in support of 870-876 MHz and 915-921 MHz

* 1. **SRD Rx performance**

**Receiver specifications**

**Introduction**

Receiver specifications have been and are still subject of a long debate in both ETSI and CEPT. Opinions of regulators and industry vary although the need for better receiver specifications is acknowledged by all. The source for discussion is partly the fact that receiver specifications may be defined for a number of technical and other reasons. The technical reasons are:

*Defining EMC:* Functioning of the receiver is influenced trough EM radiation leaking trough the cabinet or entering the cabinet trough cabling. EM energy does not necessarily enter the receiver trough the antenna port or the integral antenna. Examples are Low Frequency Detection in the AF stages of the receiver or variations in the power Supply voltage as the result of an EM field but also the spurious radiation of the receiver itself.

*Frequency management and planning:* For the functional description of a radio system usually a link budget is defined consisting of a transmitting power and modulation type, a propagation path and the minimum sensitivity of the receiver. The receiver parameters are in this case related to sensitivity and selectivity such as blocking, LO phase noise, adjacent channel selectivity etc.

*Improving spectrum efficiency:* A receiver uses the spectrum just like a transmitter. If for example the IF filter is too wide (wider than necessary for the reception of the transmitted signal), spectrum is wasted since it could be used by another receiver transmitter combination . The parameters are the same as for Frequency management and planning but the values may differ. A radio system may function without problems but could still waste spectrum resources because its receiving bandwidth is relaxed.

**Receiver category**

In the 20-1000 MHz SRD standard EN 300 220 receivers are classified in category 1, 2 and 3. Category 3 is the lowest and category 1 as the highest cagegory. Each category contains one or more receiver parameters and its associated value. The values of the parameters are set by a mix of EMC, frequency management and spectrum efficiency reasons. In the SRD world restrictions are usually based on cost versus compatibility and these parameters are no difference.

For the customer/end user and industry the category are more useful than the actual parameters because they can be easily used to show the quality or suitability of the product. It is also easy for a regulator other than the spectrum regulator to make a receiver category mandatory for a particular application. Examples are safety and alarm applications.

Categories are ok but there is a risk. A category may be modified easily in the harmonised standard without giving the non technical user or regulator info about such a change in a direct way. The manufacturer may be tempted to strive for a more relaxed set of parameters within the receiver category used to reduce cost and still give the assumption of the same quality. To avoid obscurity it might be better to introduce more sub-categories within the existing categories and do not change them anymore. For example a Category 1a, 1b and 1c, were 1b is the baseline in the form of the existing category 1 and 1a a more strict and 1c a relaxed subset of category 1. This way industry has more choice and the user has the assumption of a stable receiver category.

**Receiver categories vs Receiver parameters**

Receiver parameters have an impact on intra SRD sharing, specially were high and low power and narrow and wide bandwidth systems need to work together in the same environment.

The existing categories contain parameters for blocking an adjacent channel selectivity. A balance of power in a sharing environment is supported by defining certain values for blocking, all categories contain this value for blocking so a quality assessment in the environment based on power levels can be made. For selectivity however there is no value for the categories 2 and 3 which are the most used categories for equipment on the market. An assessment on spectrum efficiency and even establishing a predictable sharing environment cannot be made from a regulatory point of view. Existing industry seems to be happy with this situation but a newcomer may have problems with hidden receiver parameters limiting their access because the sharing environment is not that predictable. For the new frequency bands 915-921 MHz and 870-876 MHz clear bandwidth parameters should be established for all equipment that wishes to use it. It is not necessary for these parameters to be very tight in all cases since we have 3, or in the future maybe more, receiver categories.

# Outcome of Compatibility studies [ECC REPORT 200]

* 1. **Conclusion of ECC Report 200**

The conclusion of the ECC report 200 addresses the need for co-existence studies identified within the CEPT Roadmap for designating additional spectrum for SRD/RFID applications in the UHF spectrum, notably in the 870-876 MHz and 915-921 MHz bands.

The ECC Report 200 has analysed a broad range of representative SRD and RFID uses that are proposed to be deployed in the subject frequency bands alongside several civil and non-civil radiocommunications services and systems that are already in situ or proposed in CEPT countries. The ECC Report 200 also considers systems/services operating in adjacent bands. The studies have relied on a combination of methods: including Minimum Coupling Loss link budget calculations to statistical Monte-Carlo based simulations performed with SEAMCAT.

Analysis of trends (ECC Report 200 Annex 1) indicates that the pattern of current and planned use of the subject bands varies greatly across the CEPT region. This varied use has resulted in different sharing opportunities dependant on the type of systems studied and the results have been structured to enhance the sharing possibilities with each countries combination of services. In some cases SRD equipment will need to be class 2 to ensure the best spectrum efficiency whilst protecting the primary service.

Note that except for some explicit provisions mentioned below, all conclusions of ECC Report 200 are based on SRD/RFID parameters (e.g. channel bandwidths, DC and transmit power ranges) as derived from respective ETSI SRDocs.

**A. Countries where bands 870-876/915-921 MHz are used for TRR and/or UAS:**

Countries where bands 870-876/915-921 MHz or parts of the band are used for TRR and/or UAS may consider introduction of SRD/RFIDs only with certain additional considerations, such as:

* For countries that in the time of peace restrict the use of TRR to designated military exercise areas, adequate physical separation between SRD/RFID and TRR must be ensured. Under these conditions sharing with SRD/RFIDs may be feasible and further aided by requiring SRDs to use APC;
* For countries that in time of peace allow the use of TRR anywhere across their territory, especially in urban areas,
	+ sharing between SRD (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;
	+ sharing between RFID (band 915-921 MHz) and TRR will not be feasible
* For countries that allow use of UAS anywhere across their territory, especially in urban areas,
	+ co-frequency sharing between SRD (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;
	+ co-frequency sharing between RFID (915-921 MHz) and UAS will not be feasible in general;
* The countries that use the subject bands for TRR and/or UAS systems in the band 870-876 MHz may allow SRDs as Class 2 devices provided they comply with limits on power and duty cycle. Furthermore there must be certainty that the estimate for the density of devices is not exceeded;
* Sharing conditions may be improved if SRD/RFID could employ additional, more sophisticated mitigation mechanisms, such as DAA[[4]](#footnote-9).

**B. Countries where the bands 873-876/918-921 MHz may be used for ER-GSM:**

* The subject bands include sub-bands 873-876/918-921 MHz that are allocated as an extension for pan-European GSM-R systems (referred to as the ER-GSM bands). They may be used by countries that have a heavy railways infrastructure requiring additional network capacity in addition to that provided by the main GSM-R bands 876-880/921-925 MHz.
* Co-frequency sharing with ER-GSM is not generally possible without addition mitigation. It is therefore proposed that countries with plans for using 873-876/918-921 MHz for ER-GSM, may consider the following regulatory arrangements for introducing SRD/RFIDs:
	+ Within the bands 870-873/915-918 MHz the considered SRDs/RFIDs may be allowed with the parameters assumed in ECC Report 200 (see Table X);
	+ Within the bands 873-876/918-921 MHz, administrations wishing to avoid harmful interference in both typical and worst case scenarios should introduce the option 1 and/or option 2 timing restrictions for SRDs in Table X below. Administrations willing to disregard the high risk of interference for worst case scenarios, and accepting interference probabilities in the average case simulations in the order of 5%, do not require these restrictions.
	+ A further option to use ER-GSM bands for higher power applications could be a coordination procedure with the railway operator or a cognitive procedure in order to avoid the ER-GSM bands (see Option 3 in Table X).

Table X: Options for sharing with ER-GSM

|  | **Option 1: For devices with high deployment figures**  | **Option 2: For devices where low deployment is ensured by regulatory means(e.g. access points) (Note 2)** | **Option 3: Cognitive approach (Note 1)** |
| --- | --- | --- | --- |
| DC limit | * Short term DC limit Max Ton 5ms, Min Toff 995ms, and
* Long term DC of around 0.01%
 | Short term DC limit Max Ton 5ms, Min Toff 995ms | NA |
| Max Tx power | 25 mW | 500mW | For RFID at 36 dBm (4W) and SRD at 27 dBm (500 mW). A frequency offset of 100kHz from GSM-R channels is applicable |

Option 1 and Option 2 should be considered as lower and upper regulatory boundaries.

1. the DAA mechanism considered and tested for coexistence between ER-GSM and RFID devices in the 918-921 MHz band (see ) could be also adapted to identify channels not being used by ER-GSM in the vicinity of SRDs in the 873-876 MHz band

2. Low deployment means about 1 device per km2

**C. Countries that deploy Wind Profiler Radars and other than above mentioned services in 870-876/915-921 MHz:**

It was noted that UK and Isle of Man each have one remote site with a Wind Profiler Radar that are in constant use. However these administrations considered that the Wind Profiler Radars would be adequately protected from the assumed SRD applications (see Table X). They also considered that any interference events could be managed due to the very low number of WPR in operation, their remote situation and if necessary, the size of any exclusion zone that would be required to provide protection to their WPRs.

**D. Countries that do not use the bands 870-876/915-921 MHz:**

The adjacent band co-existence between candidate SRD/RFIDs and GSM/GSM-R may be feasible.

Other than consideration of sharing with other services in the subject bands, this study also addressed the feasibility of intra sharing for the envisaged broad variety of SRD and RFIDs. This proposal is of primary importance to countries that do not use the bands.

As a general conclusion, this study found that intra-SRD sharing in the bands 870-876 MHz is feasible, assuming the SRD parameters set out in the relevant SRDocs (see Table 2). Even Network Access Points with up to 10% DC may be easily accommodated in most typical co-existence situations, because their higher DC may be compensated by lower deployment figures. However additional mitigation mechanisms, such as APC may be useful measure, e.g. for SRDs with transmit power of 100 mW and higher, as means of general reduction of in-band interference noise levels.

A similar conclusion on the feasibility of general intra-SRD/RFID sharing may be drawn also for the band 915-921 MHz assuming the following frequency arrangements:

* Higher-power SRDs and RFIDs are placed in four “high power” channels;
* Lower-power SRDs are interleaved between the “high power” channels;
* Assistive Listening Devices (ALD) with DC up to 25% is also placed in the four RFID channels, assuming co-location is unlikely.

However, manufacturers of devices using the band 915-921 MHz should be aware that the channels 916.3, 917.5, 918.7 and 919.9 MHz may be used by high power SRDs/RFIDs with channel bandwidths of up to
400 kHz.

For countries that do not use the bands 870-876/915-921 MHz, the summary of these findings in terms of permitted technical parameters for SRDs being deployed in 870-876 MHz and 915-921 MHz bands is provided in the following table.

Table X: Summary of technical parameters for SRDs for countries that do not use
the bands 870-876/915-921 MHz

| **Frequency Band** | **SRD Category** | **Equivalent ETSI SRDoc** | **Max Power** | **Max DC** | **Channel arrangement**  | **Bandwidthwidth** |
| --- | --- | --- | --- | --- | --- | --- |
| 870-876 MHz | Non-specific (low power) | TR 102 649-2 | 25 mW | 1% | 870-876 MHz | Up to 600 kHz  |
| Personal wearable devices (e.g. alarms) | TR 103 056 | 25 mW | 0.1% | 870-876 MHz | 25 kHz |
| Indoor stationary devices (e.g. low duty cycle Home Automation and Sub-Metering) | TR 102 649-2 TR 102 886 | 25 mW | 0.1% | 870-876 MHz | Up to 200 kHz |
| Automotive | TR 102 649-2 | 500 mW (2) (3) | 0.1% | 870-876 MHz | Up to 500 kHz |
| Infrastructure network nodes (4) | TR 102 886TR 103 055 | 500 mW (3) | 2.5% | 870-876 MHz | 200 kHz |
| Infrastructure network access points (4) | TR 102 886TR 103 055 | 500 mW (3) | 10% | 870-876 MHz | 200 kHz |
| 915-921 MHz | Non-specific (low power) | TR 102 649-2 | 25 mW | 1% | 915-921 MHz | Up to 600 kHz |
| Non-specific (medium power) | TR 102 649-2 | 100 mW | 1% | 4 channels in 915-921 MHz (1) | Up to 400 kHz |
| Indoor stationary devices (e.g. low duty cycle Home Automation and Sub-Metering) | TR 102 649-2 TR 102 886 | 25 mW | 0.1% | 915-921 MHz | Up to 200 kHz  |
| Indoor stationary devices (e.g. high duty cycle Assistive Listening Devices) | TR 102 791 | 10 mW | 25%  | 4 channels in 915-921 MHz (1) | Up to 400 kHz (6) |
| RFID (interrogators) | TR 102 649-2 | 4 W | 2.5% (5) | 4 channels in 915-921 MHz (1)  | Up to 400 kHz |

Note 1: four channels: 916.3, 917.5, 918.7 and 919.9 MHz

Note 2: for Vehicle-to-Vehicle applications only; <100 mW for in-vehicle applications

Note 3: APC always required for applications to reduce unnecessary emission levels.

Note 4: Installation only by professionals – e.g. operator of Smart Metering/M3N network

Note 5: For RFID, a DC of 2.5% is assumed for the hot-spot scenario. In less dense scenarios higher DCs are possible.

Note 6: All ALD simulations were carried out with 200 kHz. If ALD share the channel plan with RFID, the bandwidth permitted may be 400 kHz.

Table X provides an example of a possible solution for SRD sharing in countries that do not use the bands 870-876/915-921 MHz and may not necessarily represent the final solution.

.
Where the interrelationship between power, DC and deployment density has been used further consideration may be necessary in developing regulations.

* 1. **Comments on the Conclusion of ECC Report 200**

## Annex 2 describes how a mesh network operates. Within the mesh it is essential to have Network Relay Points (NRP) to push/pull data into the network at appropriate locations. 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”.

In setting equipment regulations it may not be possible to make such restriction. There may be a need to set an alternative way of limiting the numbers of devices to the density of apparatus envisaged in the ECC Report 200 sharing study. See section 10 and X.

# Authorisation regime for infrastructure networks under the SRD framework

Article 18 of the Radio Regulations stipulates that “no transmitting station may be established or operated by a private person or by any enterprise without a licence issued in an appropriate form and in conformity with the provisions of these Regulations by or on behalf of the government of the country to which the station in question is subject”. The above term “licence” can be understood in its broad acceptance. This basically means that the use of spectrum must be explicitly permitted.

Understanding how the spectrum is effectively authorised requires actually clarifying the domain of use.

As underlined in ECC Report 132, various terminologies are commonly used to qualify the type of authorisation that is delivered by NRAs: unlicensed, licence-exempt, licence free, general licence, general authorisation, light licensing, licensed, individual licence, individual authorisation…

In the following, the term “authorisation” shall be understood as the public legal act issued by NRAs for the purpose of delivering spectrum usage rights to private entities or citizens (i.e. “non-governmental” use of the spectrum), without prejudice to the form that such acts may take in different countries.

The following two terminologies should also be distinguished, consistently with ECC Report 132:

* Individual authorisation (Individual rights of use)
* General authorisation (No individual rights of use)

Individual rights of use are given for limited duration and do not constitute property act of the frequencies by the operator as they are part of the national domain.

The figure below summarises this overview of the baseline structure of national legislation on the use of spectrum in European countries:



Figure X: national legislation from the radio spectrum to users

The prime discrimination factor is whether the spectrum is used by governmental bodies, on the one hand, or for commercial purpose or by citizens (amateur, CB, SRDs…), on the other hand. Network infrastructure systems are clearly on the commercial purpose side and hence will ultimately require a licence award on national level.

National Tables of Frequency Allocations (NTFAs) and frequency assignments

National Tables of Frequency Allocations (NTFAs) primarily specify the radio services authorised by an individual administration in frequency bands and the entities which have access to them.

National frequency assignments, as derived from the ITU concept, allows the fine management of frequency bands in accordance with the rules set in NTFAs, particularly in bands shared by different type of users and also in respect of coexistence issues in adjacent bands. They may contain sensible data and their management require confidentiality procedures.

When registered at the BR IFIC, this information becomes publicly available; the purpose being primarily the granting of international rights for protection. Frequency assignments should be well distinguished from national authorisations delivered by NRAs.

Frequency opportunities for infrastructure network systems system should be included in the European Common Allocation Table by inclusion of ECC harmonisation measure (e.g. ERC/REC 70-03), 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) 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. 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.

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 report therefore considers the possibilities regarding the authorization 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 priory 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 should be used;

ECC Report 132 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****(2) (3)** | **Licence-exempt****(4)** |
| Individual frequency planning / coordination Traditional procedure for issuing licences | Individual frequency planning / coordinationSimplified procedure compared to traditional procedure for issuing licencesWith limitations in the number of users | No individual frequency planning / coordinationRegistration and/or notificationNo limitations in the number of users nor need for coordination | No individual frequency planning / coordinationNo 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 is the preferable option for infrastructure network points (NRPs) since in line with the considerations above since:

1. there is no intention to limit the number of users or the number of infrastructure network opportunities;
2. there is a minimum technical need to coordinate the NRPs;
3. 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”.

# Proposed band plans

### 870-876 MHz Band Plan

Figure X: Band plan for 870 – 876 MHz

ERC Rec 70-03 Annex 1:

870-875.6 MHz, for Metropolitan Infrastructure Networks. A Coordination mechanism may be needed for these apparatus (e.g. registration / notification) – see section 10

ERC Rec 70-03 Annex 1

870-875.8 MHz ,25 mW, 1% DC, max 600 kHz (plus GSM-R LDC option)

ERC Rec 70-03 Annex 1

870-876 MHz, 25 mW, 0.1 % DC, 200 kHz (plus GSM-R LDC option)

ERC Rec 70-03 Annex 5

870-875.9 MHz, Automotive TTT (vehicle to vehicle 500 mW APC of at least 20 dB range, 0.1 % DC)

ERC Rec 70-03 Annex 5

870-875.8 MHz, TTT 100 mW, 0.1 % DC

### 915-921 MHz Band Plan

Figure X: Band plan for 915 – 921 MHz

ERC Rec 70-03 Annex 1:

915-915.3 MHz, 25 mW, 0.1% DC (diversity, battery life , alarms and other devices needing similar predictable spectrum sharing)

920.9-921 MHz, 25 mW, 0.1% DC (diversity, battery life , alarms and other devices needing similar predictable spectrum sharing)

915.3-920.9 MHz 25 mW, 1% DC 600 KHz

916.1-916.5 MHz, 917.3-917.7 MHz, 918.5-918.9 MHz, 919.7-920.1 MHz 100mW, 1% DC.

*Footnote on frequency hopping: accumulated dwell time per hop should fulfil the GSM-R: LDC option in 873-876 MHz 5ms/1s and 0.01/h*

ERC Rec 70-03 Annex 10

ALD 916.1-916.5 MHz, 917.3-917.7 MHz, 918.5-918.9 MHz, 919.7-920.1 MHz,. 10 mW, 25% DC 400 kHz channels (follows the RFID channel plan and restrictions to protect GSM-R)

ERC Rec 70-03 Annex 11

RFID 916.1-916.5 MHz, 917.3-917.7 MHz, 918.5-918.9 MHz, 919.7-920.1 MHz, 4 Watt 400 kHz channels no DC. However, “operation only permitted when necessary to complete the intended operation, i.e. when tags are present” – plus the DAA option for countries having E-GSM-R

# Conclusions and recommendations

* 1. **Proposed regulatory regime**

For the majority of SRD in the 870-876 MHZ and 915-921 MHz, the proposed regulatory regime is licence exemption. This conclusion is based on the sharing analysis in ECC Report 200 indicating that the proposed SRD meet the condition, set in the introduction to ERC Recommendation 70-03, that they have a low capacity to cause interference.

There is one exception to this. The Metropolitan Infrastructure Networks, when operating above a Duty Cycle of 2.5%, but lower than 10%, may need some form of coordination procedure as set out in Section 10 of this report. There does however appear two alternatives;

* If licence exemption is preferable, it will be necessary to describe the Network Relay Points (NRP) in technical terms. The sharing analysis was completed using a scenario where these NRP are used infrequently in the network and consequently infrequently in geographic space. In setting any regulation it is essential to ensure the density of NRP does not deviate from that assumed in the ECC Report 200 sharing analysis. One solution may be to specify that NRP operating at more than 2.5% DC must have a minimum number of client/slave apparatus operational within the network. In this way the density of high Duty Cycle NPR is controlled.
* An alternative would be to develop some form of coordination regime as described in Section 10. One method could be to insist that a database be completed as part of a licence exemption regime.

CEPT administrations will need to consider carefully how NPR can be authorised.

The ECC Report 200 conclusions categorised the national sharing arrangements with primary services into four categories;

1. Countries where bands 870-876/915-921 MHz are used for TRR and/or UAS
2. Countries where the bands 873-876/918-921 MHz may be used for ER-GSM
3. Countries that deploy Wind Profiler Radars and other than above mentioned services in 870-876/915-921 MHz
4. Countries that do not presently use the bands 870-876/915-921 MHz

This necessitates that although the proposed SRD regulatory regime is licence exemption, the regulations in different administrations in CEPT may be different.

As such there are likely to be different sets of apparatus made available for different markets within Europe. In the European Union, this situation is referred to “Class II apparatus”. That is to say that there will be restrictions on where particular apparatus can be lawfully operated. Manufacturers of apparatus operating in the 870-876 MHz / 915-921 MHz band will need to make it clear to users where apparatus may and may not be used.

* 1. **Recommendations**

 The suggested SRD allocations are set out in Annex 4. It is recommended that these suggested SRD allocations are transposed into ERC Rec 70-03.

List of reference

1. ETSI TR 102 649-2….
2. ECC ..
3. etc
4. Detailled Objectives set out in ETSI Systems Referrence Documnets
	1. Generic SRD

Generic SRD are already installed in large numbers across a wide range of applications within Europe in the 863-870 MHz band (see ECC Report 182 [ref]) and their use is expected to grow rapidly over the next 10-15 years. It is anticipated that the current designations of spectrum for RFID and SRDs will be inadequate to meet their future needs.

The SRD industry has expanded considerably over recent years and has now developed into a number of different industrial sectors. It is anticipated that the present trend in diversification and expansion will continue.

Based on these predictions of market growth, it is very evident that additional spectrum or more efficient use of the existing spectrum will be necessary. These points was already identified in November 2006 in CEPT Report 14[[5]](#footnote-10) in response to a mandate from the EU Commission to develop a strategy to improve the effectiveness and flexibility of spectrum designation for SRDs. The Report recommended that:

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

(ii) "New bands should preferably be extensions of SRD bands or close to them".

(iii) "Introduction of LBT and/or AFA in existing SRD bands is a first priority. However, any benefit from the introduction of LBT and/or AFA may be short lived if the anticipated growth in SRDs occurs. Therefore the identification of new spectrum for SRDs employing these techniques is a second priority".

Economic value of SRD/RFID/SM incl. their importance for the society has increased. Future proof solutions are needed, also with regard to SRD/RFID/SM as victims and changes in the adjacent spectrum (e.g. LTE). This may also include intra-SRD compatibility considerations.

Existing spectrum in 863-870 MHz is not currently overcrowded but it is evident that there is a strong device population growth and the <<noise environment>> may change as a result of new services in adjacent spectrum.

* 1. RFID

RFID at UHF is currently one of the most promising and discussed automatic identification and data capture (AIDC) technologies. The range of applications is broadening rapidly and includes new applications which incorporate other technologies such as sensors.

Market analysis shows rapidly growing sales for RFID systems.



The blue bars on the chart originated from EPCglobal and were included in CEPT Report 14 of 2006. They show predictions for the annual growth in global tag sales at UHF from 2006 to 2012. Sales in 2006 were predicted at 200k rising to 1.2 billion in 2012, which represents a compound rate of growth of 35%.

The actual sales that were achieved over the same period are shown in red. These figures were provided by IDTechEx, who are an independent and respected source of marketing data. It will be seen that in each year for which they have records, sales have comfortably exceeded predictions.

There is a wide variety of different RFID applications and this number is growing at a rapid pace. This range of applications may be listed under the following broad categories.

* **Logistics and materials handling**: Mobile assets are frequently tagged to track their movement along the supply chain. Typical examples are RFID–tagged cartons, containers and pallets, which are used at different stages during the production process. The objective is to optimize the movement of goods and achieve improved levels of efficiency. Other materials handling applications include libraries, waste management and many other applications in daily life.
* **Asset monitoring and maintenance:** RFID is mostly used to tag fixed and high–value assets. The tags contain a range of data, such as expiry dates and other similar information used for maintenance purposes. Examples include tagged aircraft spares and tagged machines where the maintenance history is stored on the tag. Where data is stored directly on the tag and not on the companies’ network, tags with large memories are often needed.
* **Processes control:** To improve management control RFID tags are attached to items, which move through a manufacturing process. Often information going beyond a simple ID number is stored on the tag to control the production processes. For example this is the case in the automotive industry where tags containing production information are attached to car bodies or smaller parts. The main benefit is the avoidance of costly errors during the production process.
* **Inventory audit:** A prominent application is the use of RFID for inventory audit. Examples include warehouses where pallets and sometimes cases are tagged to improve the speed, accuracy and efficiency of stock control. In most cases, only an ID number and EPC code is stored on the tag, which is used subsequently by the host computer to control or monitor the handling of tagged objects. *NB Also used in retail*
* **Anti-theft:** RFID tags are used at item level to prevent theft along the supply chain or at the point of sale. This takes the form of electronic article surveillance devices (EAS), which are installed at the perimeter of a controlled area. Recently the RFID and EAS functions have been combined within a single tag. This informs the shop keeper about those items that are being stolen which has a significant impact on the cost/benefit analysis.

Note: some data available about growth of reader sales Tag/interrogator ratio is heavily dependent on the application. It can range from as little as one interrogator to 100 tags up to one interrogator to 10,000 tags

It is predicted that the use of RFID in Europe will grow dramatically over the next 15 years. As the commercial benefits of RFID become more widely recognized, the technology will be adopted by many new industries. Some of these applications will require improvements to existing RFID performance. Typical examples include greater reading range, improved reading performance, faster data rates and the use of sensors (e.g. temperature, pressure, etc.) within tags. These requirements can only be met by the provision of additional spectrum.

RFID operating in the 915 to 921 MHz band will give a twofold benefit over the present 865 to 868 MHz band. The benefit of harmonisation with the USA means that tags will be read at the frequency at which they are designed to give their maximum response. Tags have a natural Q factor and typical response curve. By operating near the ideal frequency the signal received from the tag should be stronger. The increase in power and bandwidth as compared with 865 to 868 MHz increases the reading performance and potentially permits data rates that are four times faster than those currently possible.

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It is considered that designation of the band 915 MHz to 921 MHz for use by RFID will satisfy the foreseeable market requirements of the industry for the next 10-15 years.

These requirements have been extracted from the recent technical proposals generated by ETSI (European Telecommunications Standard Institute). Their System Reference Document TR 102 649 v1.3.1 requests the extension of the current UHF frequency band used in the European Community to include a second frequency band from 915 to 921 MHz.:

RecentlyEPCglobal France completed a study, which was based on responses to a questionnaire from 16 French users This questionnaire had been circulated to selected users in 2011. One aspect of the study was an analysis of the users’ perception of the benefits of RFID technology and of the challenges faced in implementing an RFID installation. The first seven questions in the questionnaire covered the extent to which current RFID systems satisfy present and future market requirements. The two last questions enabled a comparison to be made between the needs of users over the short and medium term against the proposals in the SRDoc.

The responses to the questionnaire represent around 80% of the present French market for the UHF RFID technology and cover the following types of activity:

* Aeronautics (eg : Eurocopter, Airbus/EADS …)
* Automotive (eg: Renault …)
* Retail and distribution
* Others (eg: Systerel, Check Point …)

The responses to the questionnaire showed that users expect a substantial increase in the number of applications within the next two years.This followed from the perception of end users that RFID technology is a tool that can facilitate applications in logistics and warehouse management. In addition RFID will be deployed in new applications such as customer services and transport. The responses to the questionnaire gave examples of current and emerging applications.

|  |  |
| --- | --- |
| **Applications deployed today**  | **New applications**  |
| Anti-theft  | Rail freight  |
| Anti counterfeiting  | Baggage’s management  |
| Access control  | Vehicles fleet management  |
| Airfreight  | Cross-merchandising  |
| Geo-positioning  | Point of sale (Retail and Distribution)  |
| Fleet management  | Vehicles and Aircrafts records  |
| Stock management  | Maintenance  |
| Inventories  | Food traceability (“ from plough to platter“)  |
| Customer services  |  |
| Containers traceability |  |
| Logistics  |  |
| Production management |  |

Many of the future applications will involve item level tagging at source, which will require better reading performance than is presently possible at 865 – 868 MHz. ETSI proposes to reduce the time taken to read multiple tags by increasing the bandwidth. For logistic applications it is also proposed to double the maximum transmitted power. This will help in the reading of tags in the centre of pallets, which often suffer from shielding

An analysis of the answers received showed that users have six main requirements for RFID systems.



**Analysis of users’ requirements**

The two most important requirements expressed by users are an increased resistance to interference (immunity) of the tag and adequate robustness of the interrogator, to read multiple tags, in situations where the RF environment is disturbed.

A substantial increase in the density of RFID interrogators is foreseen within the next two years. More precisely, the answers received showed that within the next two years, the demand for tags in France will increase by a factor of three and the sales of interrogators will double.

In many new applications there is a requirement to position interrogators in close proximity with each other. This can often lead to a reduction in performance due to the generation of inter-modulation products. The provision of additional high power channels with increased channel spacing as requested in the ETSI proposal will substantially allow this problem to be overcome.

The proposals in the ETSI SRDoc will help to solve the following limitations*.*

|  |  |  |  |
| --- | --- | --- | --- |
| **Needs expressed** | **Does the ETSI proposal cover the issue** | **How?** | **Comments** |
| **Enlarging frequency bands (to 6 MHz)** | **Double power compared to 865 – 868 MHz** | **Double channel width compared to 865 – 868 MHz** |
| **Robustness in a disturbed environment** | ***YES*** | **X** |  | **X** | **In case of double the maximum emitted power, coexistence of many interrogators must be managed by an adequate access technique**  |
| **Interference résistance** | ***YES*** |  |  | **X** |  |
| **Simultaneous reading** | ***YES*** | **X** |  | **X** | **Depending on how LBT is implemented, the reading speed may be reduced** |
| **Reading distance** | ***YES*** |  | **X** |  |  |
| **Objects moving at speed in front of an interrogator** | ***YES*** |  |  | **X** |  |
| **Others (maximum transmitted power,/reading efficiency/dense reader mode)** | ***YES*** |  | **X** | **X** |  |

The study reached the following broad conclusions:

The adoption of a single global frequency band for RFID will assist in achieving market growth. This is exactly what is proposed by ETSI with their request for the designation of RFID in the frequency band 915 MHz to 921 MHz. This band falls within the frequency range used in Northern America (902-928 MHz) and the frequency ranges being adopted in Asia.

UHF RFID is moving more and more towards warehouse applications where all products will be tagged. Taking into account the wide range of products stored in these warehouses typically a pallet may comprise 1000 different products. Using the present band 865 – 868 MHz, RFID will be incapable of reading all tags on a pallet within an acceptable length of time. Higher data rates will increase the number of tags that can be read.

This study showed a significant increase in the expected growth of the RFID market, in terms of geographic zones, devices deployed, and the number of applications using RFID. The needs expressed by users are focused on the requirement for improvements in the overall performance of RFID systems

***In particular the study showed that implementation of the ETSI proposal will provide the following technical benefits***:

* Increase in the reading distance by up to 35%,
* Reduction in the reading time where there are high tag populations
* The ability to read tagged items moving at greater speeds,
* The ability to install an increased number of interrogators in close proximity with each other
* Simplification in the installation of RFID systems

***The main economic advantages will be the followings:***

* Only one type of tag operating at a harmonized frequency leading to simplified stock handling of tags, optimized costs, improved deliveries etc.,
* Reduced costs for the manufacture, installation and maintenance of interrogators,
* Reduction of running expenses,
* Improvement of stock management and logistic flows,
* Better customer service.

The analysis described in this study clearly shows that the ETSI proposal fits the expressed needs.

* 1. Sub-Metering, Smart Meter

Smart Meters bi-directional devices are able to communicate both with utility providers and customers. In their simplest form they are able to give consumption and price information in near real time. As smart meter networks become prevalent, they become the enabling technology to provide the incentives to alter consumption and generation of utility resources.

Consumers are increasingly sensitive to resource consumption and in the case of power, their carbon foot print. Smart Metering is the first step in integrating consumers' wishes with the supply of these resources. It enables consumers to use resources more efficiently; this may be based on time variable tariffs or other incentives related to the demand.

Smart Metering primarily targets improvement of energy end-use efficiency as defined by Directive 2006/32/EC, thus contributing to the reduction of primary energy consumption, to the mitigation of CO2 and other greenhouse gas emissions.

According to the European Commission, Standardisation Mandate M/441, to CEN, CENELEC and ETSI, "in the field of measuring instruments for the development of an open architecture for utility meters involving communication protocols enabling interoperability".

 "The general objective of this mandate is to create European standards that will enable interoperability of utility meters (water, gas, electricity, heat), which can then improve the means by which customers' awareness of actual consumption can be raised in order to allow timely adaptation to their demands (commonly referred to as 'Smart Metering')."

Although this strictly defines Smart Metering, it is clear from the first article of the Mandate that its intention far exceeds that of Smart Meters. It particularly requests the development of an "…open architecture for utility meters that supports secure bidirectional communication upstream and downstream … and allows advanced information and management and control systems for consumers and service suppliers."

This intention of the Mandate encapsulates the notion of Smart Grid where computing and communications technologies are integrated with the power-delivery infrastructure.

There are in excess of 300 million gas and electricity meters alone which require replacing to meet the requirements of M441 and a similar number of water and energy meters. There are approximately 157 million water meters installed in Europe and although there is no legislation driving the adoption of Smart Metering for water it is expected that 31 % of all new water meters installed will be Smart or Smart enabled meters by 2016.

* 1. Smart Grid

Electricity generation from renewable and conventional energy, the efficient and reliable distribution of electrical energy are requiring solutions for decentralised small producers of electricity and operators of the electricity transport networks. Communication channels are required, which can be realised also wirelessly to some extent.

For this purpose, in particular to smart grids, there are already a number of technology and frequency options available or under discussion to meet the requirements of intelligent electricity networks: These range through PLT, GSM, ZigBee, and alternative low power radio systems.

For the realization of wireless communications for smart grid, they are predominantly using frequency bands below 1 GHz best suited.

- 450 MHz (PMR/PAMR)

- Mobile networks (PMR/PAMR elsewhere)

- Public networks (wireless access)

- 870-876 MHz (extension for SRD - applications, ETSI proposal)

Under frequency-regulatory aspects it is also decisive how far realisations are possible within the framework of the existing Regulation (individual allocations, General allocations). Also, some still pending requests outside of radio frequency regulation can affect the future spectrum requirements (security-related requirements, data protection, etc.).

Europe's integrated utility network will be subject to substantial restructuring in the coming years as a direct consequence of the ongoing liberalisation of the energy market. The present electricity supply infrastructure, which is characterised by large, centralised power stations, will evolve into a system comprising both centralised and decentralised electricity supplies including micro generators, electric vehicles as well as small and medium sized renewable sources. This process will place new demands on the engineering of these systems, including equipment specification and control. The anticipated rapid growth in the numbers of decentralised micro generators requires an advanced integration strategy to be developed. Part of this integration will be a supporting communication network to permit the monitoring and control of these generators as they are switched on and off line. This same network can also be used to assist consumers to make informed choices on their consumption.

Hence.a smart grid is made possible by robust, end-to-end communicationstechnologies. These technologies, working alongside the electrical grid, pull indata from all over the grid. Sensing devices are placed throughout the electricalgrid and in consumers’ homes and businesses. Information from the devices aresent to applications that can read and act upon the data.

Important objectives are:

* Improve Power Delivery and Quality:
	+ Automated load balancing in the smart grid;
	+ • Power quality management;
	+ • Automated switching of components of the smart grid and related protection systems
* Increase Operational Efficiency
* Automation of asset monitoring and management
	+ Analytics for decision support;
	+ Connected mobile workforce ;
* Monitor and control renewable energy sources everywhere
	+ Maintain grid stability as renewableenergy sources are added;
	+ Meet environmental targets and regulatory requirements
* Engage Customers in Energy Management
* Information and incentives for reduced or more intelligent energy usage
* Direct load controls
* Improved customer service.

The Smart Grid is the integration of technologies that permit inter alia the:

• coexistence of centralised and decentralised power generation;

• detection and resolution of emerging network issues;

• response to local and system wide inputs;

• rapid communication between peer devices and with centralised and distributed controllers;

• deployment of advanced diagnostics, feedback and control;

• coordination of attached loads and distributed resources.

In all the above cases, messages describing the situation need to be passed from the Smart Meter to the controlled or controlling entity. In circumstances which might compromise the grid reliability a real time response will be required.

Smart energy grids and smart meters are two areas which are very different and should not be treated in the same way.

Smart energy grids are ICT applications which help energy producers to gather information about the behaviour of suppliers and consumers in an automated fashion to improve efficiency, reliability, economics and sustainability and which allow for real-time adjustment of electricity production and distribution. National solutions may be possible and they need not necessarily to be wireless. Even though there are key requirements related to real-time aspects, reliability and robustness, commercial networks should be considered.

According to the responses to this public consultation, in particular from the utilities sector, the security of supply of energy distribution is critical for society, and this is where smart grids and the related ICT infrastructure and service platform will have a key role in the future. It is considered that the load demand on distribution networks will increase as a result of the introduction of electric vehicles, heat pumps and decentralised energy resources, including renewables, and that the challenge to match demand and supply of energy flows within a grid will intensify.

The respondents listed a number of specific security and resilience requirements for ICT infrastructures and services within smart grid systems, in particular resiliency (including power independency) and reliability to achieve high availability, quality of service, real time transfer of information, end-to-end security, protection of confidentiality, authenticity and integrity of data, as well as centralised authentication and remote access control.

Distribution automation, or management and control of the smart grid network, as the most mission-critical area where communication between the primary stations is very important for the stability and operational safety of the networks, and where wired communication solutions, such as fibre optic networks, are currently the preferred solution due to the high level of requirements. However, the general opinion is that wireless solutions will also play an important role in the future smart grid, especially in the lower voltage sections of the distribution grid, where mission-critical communication needs are foreseen to increase.

The existing views on the most suitable ICT infrastructure are diverse. Although some proponents promote their own (cable, radio or satellite based) solutions for part or most of the smart grid data communication purposes, many views were expressed in general in the opinion that the ICT infrastructure used for such purposes will be composed of a mix of different wired and wireless communications, including powerline communication (PLC). This is because each transmission technology has its advantages and disadvantages and subsequently an appropriate combination will enable the market to deploy the services faster and improve the security aspects. However, some argued strongly that PLC is not suitable for any mission-critical kind of telecommunication, as high-frequency transmission on non-shielded lines can pick up external electromagnetic fields and might not work over long periods of time, or because data communication using PLC is not any more possible in case of electricity failure. PLC may also not suitable for gas and water metering purposes.

It is indicated that both wired (mainly fibre) and wireless communications will be very important components of the communications network to support the smart grid of the future. Fibre is appropriate to connect main locations and where high data rates are used (whether aggregated or not), while wireless technologies are needed to provide access to many dispersed end points. The views regarding the portion of communications in smart grids that can be handled via fixed connections are diverse; some say that this portion will be diminishing in the long term, while some others argue that biggest part of mission-critical smart grid communications might be handled by fixed connections in the long term.

From the utilities sector, as well as some equipment manufacturers, estimate that as communication between secondary substations and the associated systems is becoming more important, dedicated or exclusive spectrum for a specific utility application would be the necessity to have optimal control over the wireless solutions, especially as certain non-exclusive spectrum bands may not be appropriate for mission-critical applications. The reasons for the potential inappropriateness listed by some of the utilities include unfavourable licence conditions, inadequate nature or unpredictability of the applicable sharing conditions of available spectrum bands and unsatisfactory protection against (harmful) interference. The smart grid ICT infrastructure could also be in the responsibility of the utility / grid operator, so that it could operate and manage it, whether it was provided by a telecom operator, a competent third party, or the utility itself. The main issue in this respect is that the utility needs to trust the communications since it has to rely on it for all the critical grid management functions.

Most of the national administrations don’t see a justification for dedicated or exclusive spectrum for smart grid services, noting that there are very rare occasions when designating spectrum for a specific service is necessary and stating that any such justifications should be carefully considered, taking into account both technical and economic aspects. Many of them are also in the opinion that existing communication network infrastructures should be sufficient to cover any energy grid specific critical demands. However, a number of them admit that there is no universal answer to the issue of the 'ownership' of the necessary ICT infrastructure/platform; they indicate that this is a matter to be worked out in each market and that the solution may differ from country to country.

In the future, real time monitoring as well as remote measuring and control will increase significantly throughout the grid, partly due to the growing share of renewable energy sources (including private wind and solar plants) and electric vehicles (need for authorisation and billing in charging stations) as well as the increasing use of machine-to-machine (M2M) communications. This will increase the role of ICT/IoT in the process of controlling the network, as well as the need for wireless solutions.

**However, the frequency management will focus on technology and application-neutral solutions to keep flexibility, avoid spectrum fragmentation and foster innovations. At the same time, some applications need very predictable sharing environments. The usage of the terminology M2M or IoTin this respect translates to the non-specific SRD type of use combined with application-neutral medium access conditions. This is in line with the concept stipulated in Draft CEPT Report 44.**

When it comes to the potential problems or risks with the deployment of smart grids, majority of the respondents referred specifically to the issues of security and data privacy, where concerns have been expressed by end customers in several occasions.

The European Commission issued mandate M/490 in March 2011 to the European Standards Organisations with the aim of supporting European Smart Grid deployment.

"For this purpose, in particular to smart grids, there are already a  number of technology and frequency options available or under discussion to meet the requirements of intelligent electricity networks:These range through PLT, GSM, ZigBee, KNX and alternative low power radio systems."

The objective of this mandate is to develop or update a set of consistent standards within a common European framework that integrating a variety of digital computing and communication technologies and electrical architectures, and associated processes and services, that will achieve interoperability and will enable or facilitate the implementation in Europe of the different high level Smart Grid services and functionalities.

CEN, CENELEC, and ETSI were requested to develop a framework to enable European Standardisation Organisations to perform continuous standard enhancement and development in the field of Smart Grids, while maintaining transverse consistency and promote continuous innovation. The deliverables from this mandate are:

• A technical reference architecture, which will represent the functional information data flows between the main domains and integrate many systems and subsystems architectures.

• A set of consistent standards, which will support the information exchange (communication protocols and data models) and the integration of all users into the electric system operation.

Sustainable standardization processes and collaborative tools to enable stakeholder interactions, to improve the two above and adapt them to new requirements based on gap analysis, while ensuring the fit to high level system constraints such as interoperability, security, and privacy, etc.

Smart grid to support infrastructure for Electric vehicles and their Infrastructure:

Many countries are encouraging the sale and promotion of electric vehicles by various means and in a number of European cities there are on-going activities to support their use.

The French government plans to acquire 50,000 electric cars for use by public companies and local authorities. In Germany, the Minister of Transport announced in November 2009 the support of development of electro-mobility by the German government with 1.4 billion Euros over the next few years.

In September 2009, a contract was placed for the delivery of 100,000 cars before 2016, to be sold in Denmark and Israel. A Danish energy supplier will establish the complete charging infrastructure in Denmark and the Danish government announced reduced taxes for electric cars to support this activity. Also in September, the Spanish government provided 10 million Euros for their program "Movelle" to introduce electrical cars in Spain.

Each of these initiatives to promote the manufacture, sale and use of electric vehicles places demands on the charging infrastructure and associated Smart Metering for customer billing. Although the charging infrastructure has not yet been standardised this is being actively pursued.

* 1. Short Range Device, Metropolitan Mesh Machine Networks (M3N) and Smart Metering (SM), (M3N)

M3N combines to some extent the smart metering and smart grids by means of meshed networks. The introduction of meshed networks is intended so that utilities can operate moreefficiently and cost-effectively than ever before.

A M3N is a network composed of the following of elements: Endpoints (Sensors and Actuators), Routers and Gateways.

Sensors and Actuators

Sensing nodes measure a wide range of physical data, including:

• Municipal consumption of gas, water, electricity, etc.

• Municipal generation of waste.

• Meteorological such as temperature, pressure, humidity, UV index, strength and direction of wind, etc.

• Pollution such as gases (sulphur dioxide, nitrogen oxide, carbon monoxide, ozone), heavy metals (e.g. mercury), pH, radioactivity, etc.

• Environment data, such as levels of allergens (pollen, dust), electromagnetic pollution (solar activity), noise, etc.

Sensor nodes run applications that typically gather the measurement data and send it to data collection and processing application(s) on other node(s) (often outside the Network). Sensor nodes are capable of forwarding data.

Actuator nodes are capable of controlling devices such as street or traffic lights. They run applications that receive instructions from control applications on other nodes. There are generally fewer Actuator nodes than Sensor nodes.

Routers and Gateway

Routers form a meshed network over which traffic between endpoints and gateways is dynamically routed. Routers are generally not mobile and need to be small and low cost. They differ from Actuator and Sensor nodes in that they neither control nor sense. However, a Sensor node or Actuator node may also be a router within the M3N.

A Gateway is a Router node which also provides access to a wider infrastructure and may also run applications that communicate with Sensor and Actuator nodes.

Benefits of M3N -

M3N systems are intended to support a large number of applications around a metropolitan area including water meters, waste management, pollution management, parking management, public lighting and self-service bike rental, to name but a few. Wiring the assets of all of these devices would be costly, and so the available of a ubiquitous network, offering low incremental costs of connection to new applications as they come along, with make them commercially viable.

Cellular networks has previously been used to connect remote devices to private control network, and as long as the interconnected devices have a high value such as town information display and parking meters; the cost of embedded modules is a small proportion of the overall cost in these cases.

Many of the new Machine-to-Machine devices, however, are todays more and more often low cost, battery powered and transmits only small amounts of data. Cellular modules are consequently too expensive and consume too much power for such applications especially.

* 1. Surveillance Alarms, Fire/Smoke alarms,Intruder alarms, Social Alarms,

Alarm systems are typically telemetry systems that require a very low latency of operation when activated. They also need a very high probability of operational success. They therefore typically prefer to avoid heavily congested channels.

 In most of the cases wireless alarm sensors are battery powered, which leads to a restricted operating time. To cope this restriction manufacturer try to find the optimum balance between transmission power, telegram length and duty cycle. To increase e.g. the transmission reliability by repeating the telegram 2 times will reduce the operating time by 70%..

Alarm systems include

• Social alarms - alerting when a person with reduced capabilities is in distress

• Fire/Smoke alarms – intended to protect life/property by alerting the early signs of fire.

• Intruder alarms – alerting the presence of unauthorised persons

• Surveillance alarms - alerting when remote sensors trigger.

EC Spectrum Priorities

Wireless alarm systems are operated in general under the Short Range Devices (SRD) regulatory framework in SRD-bands (mostly at 868 MHz in Europe) under the following conditions:

1. SRDs in general operate in shared bands and are not permitted to cause harmful interference to radio services;
2. that in general SRDs cannot claim protection from radio services;

There is no dedicated frequency allocation in Europe for alarms other than in the SRD bands.

It has to be noted, that the request for “efficient use of spectrum” in the case of alarms/social alarms has to be rated/estimated other than in the case of generic SRD. Before the situation of an emergency alert the dedicated frequency spectrum should be free, or at least occupied only by alive/maintenance messages( e.g.1/day/device). In the case of an emergency situation the alarm system should not compete with other applications in the same band which may decrease the reliability/performance of alarm systems significantly.

In the case of an emergency alert several alarm devices in a certain location may become active depending on the type of alarm. Efficient use of spectrum could be defined of the undisturbed alert transmission during an alert situation and not in between.

There is an increasing demand for wireless alarm systems even due to ongoing establishment of the legislation in the member states for safety reasons in new and existing buildings. Wireless alarms are preferred used in existing buildings (households, public buildings (schools, hospitals ...) historical buildings or environments).

While for new buildings wired solutions can be considered during planning and which offered a higher reliability, the existing buildings may not be equipped with these safety related systems by the owner due to e.g. economic constraints.

Social alarm devices are in general portable (body worn) or at least nomadic (adaptive environmental locations) and therefore have to be wireless.

Social Alarms - In a report issued by Eurostat, the Statistical Office of the European Communities it is projected that the EU27 population to continue to grow older, with the share of the population aged 65 years and over rising from 17.1% in 2008 to 30.0% in 2060, and those aged 80 and over rising from 4.4% to 12.1% over the same period.

By definition Telecare is responsive to incidents and occurrences that may prove dangerous for the client. It has been proved that it can reduce the consequences of falls of the elderly and help prevent adverse events in persons with Dementia. The use of Telecare can help deliver a range of benefits including:

• Reduce the requirement for residential/nursing care

• Reduce the burden placed on carers

• Reduce Intermediate care after hospitalisation

• Reduce acute hospital admissions

• Reduce the consequences of accidents and falls in the home

• Support hospital discharge and intermediate care

The result of using Telecare is substantial cost saving for the care provisioning services both in the socioeconomic community and in the hospital.

Fire/smoke Alarm - The total alarm time and the alarm transmission with a high reliability are very important. The following key points are taken as arguments to install smoke / fire alarm systems.

1. To reduce the amount of loss (material)

2. To reduce the number of people killed by a fire

Most victims in such fires die due to smoke poisoning. It is therefore essential that, in the event of a fire, all people in a building are warned within the first few minutes in order to evacuate the building within the time the fire brigade needs to get to the place of the fire. Smoke alarm devices are the best possible way to warn people in a very early stage of the fire. In countries like USA, UK and Sweden, where these devices have had to be installed by law for many years, the numbers of victims has been reduced by up to 50% since the introduction of these regulations.

Intruder Alarm - In the past years the number of crimes (domestic burglary / dwelling), see Table 5.3 and the damages by building insurance has been going down (source http://epp.eurostat.ec.europa.eu/portal/page/portal/crime/data/database). But the financial cost of this is going up. The main reason therefore is the increase in value in the contents of private households.

Surveillance Alarms - Building surveillance is part of the global management of buildings including access control, temperature regulation, ventilation, electricity generation and consumption and also lifts and automated doors.

Building management is a set of functions like the management of vacancy, alert treatment in case of scenario, fire detection…

Typical building surveillance and technical alarms are comprised of centralized control panels which are connected to monitoring offices via wired IP, or wireless GPRS, GSM, KNX; a variety of sensor devices, and a wireless receiver for interfacing between the control panel and sensor devices. The monitoring office can be in the building or at a remote monitoring centre.

Technical alarms are typically

- flooding or leakage alert

- over temperature detection

- lift failure detection

- automated system failure alert

- abnormal event

- emergency door kept open

- pressure failure detection

EC Spectrum Priorities

**Justification**

The Commission Decision for SRDs foresees a regular update of the list of frequencies, as well as their associated conditions of use. This update should be performed on a regular basis in order to take due account of the rapid technological and market developments prevailing in this area. This permanent Mandate to CEPT is to formalise the preparation of the yearly proposal by CEPT for updating the technical annex of Commission Decision on SRDs.

**Objectives**

In addition to the core objectives of the Decision itself, the aim of this permanent mandate is to provide relevant technical information necessary to:

1. Modify, whenever appropriate, the technical conditions of use of the frequency bands included in the technical annex;
2. Identify new frequency bands and/or new applications (types of SRDs) which should be added to the list included in the technical annex of the Decision in order to further the “Class I” equipment category and providing such equipment with legal certainty on EU level, thereby consolidating the Single Market through spectrum harmonisation;
3. Remove frequency bands (and hence types of SRDs) from the list included in the technical annex, when required and duly justified (e.g. in case a particular use has become obsolete);

Continuously improve the presentation of the technical annex to reflect best practices.

The successive updates of the technical annex of the SRD Decision have led to the harmonisation of a number of sharing arrangements that rely on the "type of short-range device" categories in the technical annex to govern the coexistence between SRDs. However, these categories lack legal certainty as their purpose in the technical annex of the SRD Decision is not yet defined. In addition, it is necessary to establish predictable and reliable sharing arrangements in SRD bands while preserving the innovation potential of non-specific SRD designations.

In order to achieve the overall objective to harmonise SRD designations with least constraining usage conditions, an improvement of the regulatory approach for SRDs is warranted to remove application-specific restrictions and to foster beneficial sharing opportunities (BSOs) in harmonised licence-exempt bands based on **non-application specific sharing arrangements that are legally ensured in the internal market**.

Market information

Fire & Smoke

Fire and smoke detectors are mandatory for public buildings. Therefore installations for public buildings represent 93% of the market. The remaining installations are in residential areas. This market is growing 3.3% per year.

The European fire and smoke detectors market represents 1.2 billion € with roughly 9 Million detectors.

As there are approximatly 220 million households in Europe, the listed countries represent already 120 million of them (54.5%). More will follow. Many of these regulations require smoke alarm devices in sleeping and living rooms, which makes approximatley 4 devices resulting in a total of about 468 million devices in these countries only. In other European countries fire brigades advertiseing the benefits of such devices which creats an even higher demand for smoke alarms. Assuming that at least 20% will use wireless networking features, a total of more than 94 million wireless smoke alarm devices will be installed during the next 5 years. A market which will generate more than 5 billion Euros for wireless smoke alarm devices within the next 5 years.

Building Intrusion / Security

Security installations in Europe represent roughly 700000 new installations per year including 8 to 10 devices as an average including as well public and residential installations. That represents an increase of 7 million of devices each year.

There are currently 30 million installations. 25% of these installations are based on wireless devices. Therefore the today installed basis of wireless security devices is 80 to 100 million devices.

The global European market of security represents a total turnover above 2 Billion € with a growth of 3.5% per year (average value over the past ten years). This turnover can be split into 1 Billion € for wireless devices and 1Billion € for related services like remote control centre.

Social Alarm

The total Western European social alarms market in 2005 was estimated to be at$220.3 million. An estimated 734,000 units were sold and the market for social alarm appli-cations is further expected to expand of 6.1 percent over the period of 2005-2012. The penetration level for these applications as part of health and social care services stands at 4.5 percent among people aged 65 and above.

The social alarms market in Europe is influenced by many drivers with the key one being the aging EU population. This is evident from the growth in the elderly segment which is estimated to grow at a CAGR of 1.46 percent from 2003-2006 as opposed to the negative growth of 0.22 percent between people aged 15-64. This demographic trend indicates a rise in the number of dependant people aged above 65, living longer and requiring more demanding health and social care services. Rising health and social care costs to meet the increasing needs of the elderly is a major issue across all EU countries. The population of

informal carers are decreasing due to migration, smaller dispersed families and also due to

the declining practice of caring for the elderly within the family setting.

This trend indicates rising opportunities for Information and Telecommunications infrastructure providers, social alarm equipment suppliers and community service providers in the

future.

* 1. Automotive Active Safety, Automotive Diagnostic data exchange, Automotive Freight protection, Automotive Environmental & safety systems

The general trend within the automotive industry is that short range communication services are developing rapidly and is expected to be expanded further over the next 10-15 years due to e.g raw material economy, weight, vehicle integration, functionality on safety, security, environment and comfort. This includes new radio communication services and applications to meet the increasing regulatory requirement for improved road safety and sustainable driving but also a technology paradigm shift where wireless communication replaces in car wired systems and where comfort systems and integrated infotainment systems are required by the customers.

The automotive industry is operating with a lead time of 7 years and a 15+ year’s lifetime of vehicles. A long term and sustainable spectrum planning is important.

Automotive SRD applications include:

• Future comfort services in and outside of the vehicle such as activating vehicle facilities and status telemetry information;

• Road-safety/security applications where a predictable sharing environment is justified such as wireless sensors and vehicle alarms, diagnostic data exchange, freight, freight protection.

Short Range Devices currently perform a variety of important functions in modern automobiles including keyless entry/immobilisation. In accordance with information provided by the European Automotive Manufacturers Association (ACEA), the existing passenger car fleet in Europe (ACEA: "Vehicles in use" in 2005) [ref] consists of more than 250 million vehicles. By 2015 the number of vehicles in Europe is expected to increase to 400 million. Currently approximately 60 % of these vehicles are equipped with one or more SRDs. Approximately 6 million new vehicles are sold in Europe every year. 80 % of all new vehicles are currently equipped with SRD devices. Thus in future SRD equipment will be universally used by all vehicles on the roads in Europe.

In addition the variety of different SRDs used in vehicles is also increasing. This includes traditional remote keyless entry systems, which are developed further into passive entry systems and personal car communication systems. Also the adoption of safety related systems such as Tyre Pressure Monitoring Systems (TPMS) and Truck-trailer communication systems is increasing. In addition the deployment of security systems using SRDs is growing including vehicle alarm systems; diagnostic data exchange; freight protection and environmental systems. The adoption of short range communication services within the automotive industry is developing rapidly and is expected to grow further over the next 10-15 years. This is due to such factors as material savings, weight reduction, vehicle integration, safety, security, environment and comfort features. There is a general shift from car wired systems towards wireless communication, which offers improved comfort and convenience. This includes the introduction of integrated infotainment systems that are increasingly requested by customers.

The growing requirement for safety related devices, which are often mandated, increases the need for additional radio spectrum. To provide the increased reliability required for such applications, they should operate in a predictable sharing environment. This could be achieved by designating a sub-band of spectrum to a number of specified SRD services. This is applicable to both automotive and to other safety related services.

New active safety systems are required in vehicles and TPMS will be an integral part of measures required by the European Commission with the objective of achieving the EU policy targets for CO2 emissions. By November 2014 TPMS systems will be mandated in all new vehicles.

A considerable number of malfunctions of the keyless entry systems are reported by customers and this trend will further increase as a consequence of the increase in general SRD applications operating in the existing frequency bands.

* 1. Assistive Listening Devices(ALD)

Hearing loss will affect some 1 in 4 people during their lifetime resulting in loss of communication and their quality of life. In education this disability, if not corrected by ALDs disadvantages children and reduces their life chances. In many countries babies from 6 weeks old are fitted with ALD also cochlear implants are increasing in use throughout Europe, an ALD is an integral part of wider communication for those with implants.

Whilst hearing aids where initially little more than an audio amplifier these have evolved into sophisticated digital devices with their communication links upgraded from a simple inductive Telecoil system to radio links for communication with teaching systems ,mobile phones., entertainment centres and in the case of young children :their parents.

The current TR 102-791(ref1) seeks to update the single channel inductive Telecoil system with its limiting physical installation constraints to a radio based digital system which can be effectively and simply used in a wide range of public arrears such as airports[[6]](#footnote-11), train stations and theatres with multiple channels to enable features such as multiple translations.

The upgraded system is referred to at the Telecoil Replacement System (TRS).

In order to achieve TRS, given these systems will be used worldwide common spectrum is required.

1. Mesh Technologies
	* + 1. Mesh Networks, How do they help?

Ofcom UK [[7]](#footnote-12)published in 2006 a research paper on Mesh Networks. The summary of this report is;

Mesh networks have the potential to bring several advantages to wireless communications services, namely:

* They can allow the formation of a new type of network where users exchange information without the need for network infrastructure. As well as allowing a different commercial model it is often claimed these are more spectrum efficient.
* They can extend coverage of cellular and other networks by allowing terminals on the edge of the coverage zone to relay signals to those who do not have coverage.

An often quoted vision of mobile communications describes the future as the integration of all mobile and wireless nodes (e.g. cellular, WLAN, PAN etc) with an IP core. One potential application of mesh technology would be to provide another route, alongside WLAN and 3G etc, into such a core network.



**Figure 1** mobile integrated vision using IP core

* + - 1. Mesh Attractions

Perhaps the largest attraction of meshes is that they can be entirely unplanned. This is useful to the military and to disaster recovery teams who desire this ad-hoc networking capability for fast deployment and flexibility in situations with little fixed infrastructure. It is less clear what this benefit brings to the roll-out of a mass market mesh network, although for a service provider or regulator, the lure of a network which promises no planning phase must be high and thus merit investigation.

Another strongly attractive feature is in coverage, where they can offer complimentary performance to that of cellular systems. Meshes have the ability to provide coverage in cluttered environments such as the urban environment. A chain of mesh nodes can ‘hop’ around corners in an urban environment in a way the cellular P2MP systems cannot.

Ofcom researched mesh networks to:

* identify the theoretical determinants and metrics of spectral efficiency for both high frequency (line of sight) and low frequency (non-line of sight) mesh systems
* investigate the capacity constraints of mesh networks and examine the hypothesis that for a mobile mesh the more consumers use a service, the more capacity the network has
* investigate whether mesh systems have any regulatory impact, e.g. would the wider use of mesh systems imply that there should be more licence exempt spectrum?
* examine the key problems in the delivery of fixed and mobile mesh systems, understand what is required to resolve these and what the timescales for widespread adoption of mesh might be.

Ofcom investigated mesh networks to understand the true practical benefits that the technology might bring.

The work we have commissioned in this area is addressing questions such as:

* Are meshes more spectrally efficient than alternatives?
* Can meshes enable the use of higher frequency bands, and/or support services-types that alternatives cannot?
* Are meshes practical, and what are the enabling technologies?

Our work in this area will cover both fixed and mobile mesh applications. The work presented here concentrates on mobile mesh applications, though some of what is said will apply to the fixed case also.

The work has shown that in discussing the performance of mesh systems care must be taken since the type of mesh used and its application can lead to very different conclusions regarding the performance that may be expected.

* + - 1. Capacity and Scalability
			2. Do customers self-generate capacity in mesh?

There are huge attractions to having ‘self generation of capacity’ in a radio network. Notably, that the network is self-sustaining and that it could avoid the so-called ‘tragedy of the commons’. Such a tragedy relates to the days when common land was used for the grazing of livestock with free access for all. The danger is that free access to a finite resource can result in that resource being fully consumed or compromised further such that it loses its usefulness to all. What then, if each user were somehow to add grazing capacity as they joined the common?

The hypothesis that in a mesh network the subscriber base self-generates capacity is crucial for understanding the likely applications and performance of mesh systems. To establish whether this hypothesis is valid in practical applications, four published approaches supporting this standpoint have been reviewed. Each presents a coherent argument based on its stated assumptions, however those assumptions do not translate well to practical applications. The assumptions were:

* unbounded latency for network traffic
* unbounded requirements for spectrum
* confinement of nodes into localised groups in a large mesh

These assumptions place a significant limit on the applicability of the self generating capacity. The work has concluded that for a pure mesh, subscribers cannot self-generate capacity at a rate sufficient to maintain a target level of per-user throughput regardless of network size and population. The only viable ways scalability can be achieved are by providing additional capacity either in the form of a secondary backbone (fixed) mesh network – so forming a “Hybrid Mesh”, or an access network – so forming an “Access Mesh” as shown in Figure 2. In these two configurations scalability is possible and has similar characteristics to that of a cellular network.



**Figure 2** Hybrid Network: Intra-Mesh traffic with Infra-structure support

The conclusion from the work undertaken is that meshes have no especially good properties with respect to scaling. In particular as node density and geographic size increase, the traffic rate available to any particular user decreases. The implication of this is that mesh networks should not be chosen over cellular networks on the basis of capacity alone.

This work shows that this lack of scalability can only be overcome by either adding additional capacity in the form of a hierarchical network or containing the end-to-end traffic flows to localised regions within the network

All current theory and measurement of ideal, novel and practical meshes conclude that ad hoc mesh networks comprising only peer-to-peer communication links do not scale well with increasing node population unless there are specific limitations on the density of nodes; the propagation environment and the traffic models.

Additionally there exist practical MAC and routing challenges which further push for meshes which have a low hop count – and hence localised traffic flows.

* + - 1. Underlying causes of limited capacity

Transmissions from nodes in a mesh extend beyond the wanted range to a wider ‘interference zone’, as shown below. Other nodes wanting to communicate within this interference zone must use other elements of time/bandwidth resource. Given that this is a finite resource this can lead to bottlenecks in communications across these interference zones, particularly as node density rises.



**Figure 3** Mesh node interference (each colour represents a different frequency channel)

Clearly it is advantageous to keep this area, a, as small as possible. This confirms the conclusion of other researchers that short hop lengths and high propagation attenuation factor are conducive to high throughput capacity of the network.

* + - 1. Project status

Our work in this area addresses the role that mesh networking will play in support of our vision of future wireless devices providing high bandwidth connections at home, in the office and outdoors.

The work concludes that meshes work best for the scenario of connections to extra-mesh services such as the telephone network and the Internet. This type of mesh will support applications such as extending hotspots to wider areas, provision of broadband networks and internet to rural communities, or provision of wireless networking at lecture halls or conventions.

Such mesh networks therefore will require infrastructure for deployment in the form of access points to connect to the external network. The work concludes that mesh networks can scale and provide a sustained level of service as new users join as long as the density of such planned access points is kept sufficiently high. This represents a form of ad hoc network in that users may join in an ad hoc manner, but the infrastructure itself must be planned and scaled, very much like cellular networks. Such meshes will not be as quick to deploy as pure intra-meshes, however will still be quicker to install than any new wired or cellular system, so will still have clear benefits as an alternative in some applications. An example application might be deployment to cover a new industrial park or a temporary conference event. Thus we view meshes as likely to play a role in our vision of increasingly mobile communications, supporting the ability for mobile devices to increasingly connect to broadband networks at any location.

For a pure mesh network where there is no infrastructure to provide connections to external networks such as the internet, the benefits of rapid set-up and tear down are accrued. It is in this area that meshes were originally used in defence applications and are likely to find further application in emergency service operations where planned infrastructure is unavailable. However, for this type of pure mesh subscribers cannot self-generate capacity at a rate sufficient to maintain a target level of per-user throughput regardless of network size and population. Thus this type of mesh is unlikely to find widespread commercial application.

The work has shown that meshes are not an improvement in spectrum efficiency in practical cases in comparison for example to cellular networks. Improvements in spectral efficiency of a mesh network can be made through the use of directional antennas, however this is likely only to be available to fixed mesh applications. In the mobile case small handset sizes preclude the benefits of spectral efficiency.

Improved utilisation of the spectrum is possible however since many of the applications for mesh networking can be efficiently deployed at the higher frequencies outside of the congested high demand spectrum.

1. Replies to CEPT Questionnaire on the use in 870-876 MHz and 915-921 MHz
	* + 1. Heading 4 (style: ECC Annex heading4)

Replies were received from 43 administrations by 1 August 2012 (countries in bold).

|  |  |
| --- | --- |
| **Albania****Andorra****Austria**Azerbaijan**Belarus****Belgium****Bosnia Herzegovina****Bulgaria****Croatia****Cyprus****Czech Republic****Denmark****Estonia****Finland****France****Georgia****Germany****Greece****Hungary****Iceland****Ireland****Italy****Latvia****Liechtenstein** | **Lithuania****Luxembourg****Former Yugoslavian Republic of of Macedonia****Malta**Monaco**Montenegro****Moldova****Norway****Polen****Portugal**Romania**Russian Federation**San Marino**Serbia****Slovak Republic****Slovenia****Spain****Sweden****Switzerland****The Netherlands****The United Kingdom****Turkey****Ukraine**Vatican City |

Two questions were included in the questionnaire and all administrations which answered have provided responses to both questions.

**1 Existing Usage in 870-876/915-921 MHz**

This overview shows that the real implementation of PMR/PAMR is not high in Europe, despite of having ECC/DEC/(04)06 and reflection in the ECA table. PMR/PAMR systems are currently used in only six countries in this frequency band 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 be simply unused (no licences awarded). One country plans to move from defense 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, Spain: 4 local licenses. 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) are at mid 2013 also planning with E-GSM-R, although this needs still to materialize in the market.

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

**Responses received by 1 August 2012**

|  |  |  |
| --- | --- | --- |
| **Country** | **What is the current use of the bands 870-876 MHz and 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 favorite 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); | E-GSM-R (also reflected in ECC Decision (04)06 and ECC Decision (02)05) |
| Bosnia Herzegovina | PMR/PAMR as per Rule 50/2010 which transponded stipulations of 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 (defense usage). Governmental usage will stay in the future and will not change. | No change |
| Croatia | Military services, PMR/PAMR/ E-GSM-R. No PMR/PAMR networks are implemented/in operation in the market and intention to close the governmental use in this band. | Indicated that only E-GSM-R 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 Decision (04)06 (i.e. category 2). Current holder of block assignment has terminated operation of CDMA network, however licence is valid until 2015.The bands 875.8-876/920.8-921 MHz are guard bands (no utilisation). | Short plans: There is no short plan until we will get 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. |
| 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 the above mentioned 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 for the applications mentioned above will be maintained in the future. Sharing of the 870-873 MHz band with secondary SRD applications is not considered.  |
| 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 MHz/ 915-918 MHzGovernmental use(implemented, exclusive usage)873-876 MHz / 918-921 MHz E-GSM-R (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 E-GSM-R 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 MHz and 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 – 872MHz and 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 (whole 2 x 6 MHz) | No changes planned |
| Latvia | Identified for Wide Band Digital Land Mobile PMR/PAMR systems (according to ECC/DEC/(04)06)At this moment the band is not used. | Short term (3-5 years):Wide Band Digital Land Mobile PMR/PAMR systems (according to ECC/DEC/(04)06)Long term (5-10 years): no changes or adjustment to harmonised use of the band in Europe |
| Liechtenstein | 870 – 873 MHz: Until today no RIS and no use.873 – 876 MHz: RIS RIR0501-01 and RIR0501-05. Land mobile/GSM; individual assignment due shortly915 – 918 MHz: Until today no RIS and no use.918 – 921 MHz: RIS RIR0501-03 and RIR0501-05. Land mobile/GSM; Individual assignment due shortly  | 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.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. |
| Lithuania | No use | PMR/PAMR according to ECC/DEC/(04)06 |
| Luxembourg | 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 873-876MHz/918-921MHz.4. Luxembourg recently granted a temporary licence for the band 870-876MHz 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 MHz and 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 networks; | No plans |
| 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 & 915,5-1921 designated for individual service neutral licenseNo 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 used915 – 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 bandb) introduction of harmonized 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 (E-GSM-R 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 MHzARNS on primary basisBand 915-921 MHzARNS on primary basisSpace operation service for telemetry, tracking, and control purposesMobile, except aeronautical mobile on secondary basisBand 916-921 MHzRFID  | Decommissioning of ARNS after the end of depreciation period and deployment same service in other bands |
| Serbia | Defense 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 data. Technologies could be LTE or WiMax. | No change planned.  |
| Sweden | No use  | No short term plans for this band. Awaiting the results of the EC Spectrum Inventory.  |
| Switzerland | 870 – 873 MHz: Until today no RIS and no use.873 – 876 MHz: RIS RIR0501-01 and RIR0501-05. Licences will be assigned shortly915 – 918 MHz: Until today no RIS and no use.918 – 921 MHz: RIS RIR0501-03 and RIR0501-05. Licences will be assigned shortly | 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.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. |
| The Netherlands | Military | Military use for the foreseeable future, new equipment has recently been purchased. |
| Turkey | 870-876 MHz: Designated to PMR/PAMR and Fixed Links. No implementation yet.915-921MHz: Designated for PMR/PAMR. No implementation yet. | No plans yet. |
| Ukraine | 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 organize of BS->AS communication links (deadline of technology usage – 1st January, 2016).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. | For a present day, there are no plans concerning conversion of the bands 870-876 MHz and 915-921 MHz in future, after the termination of their use by above-mentioned REFs. |
| United Kingdom | In the UK the bands 870-872 MHz and 915-917 MHz are allocated to the Military.The 872-876 MHz and 917-921 MHz bands are allocated for civil use (but not used for some time now).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 military have identified their bands for commercial sharing opportunities under its Defence Spectrum Reform work. Should the use of these bands be changed to SRD, MOD will review any contract it has agreed and consider its position.The 2011 UK Government initiative, “Enabling UK growth – Releasing public spectrum, Making 500 MHz of spectrum available by 2020” (page 35) identified that there may be the opportunity to release the military bands 870-872 MHz and 915-917 MHz.<http://www.culture.gov.uk/images/publications/Spectrum_Release.pdf>In 2009 Ofcom consulted on the release of the civil bands <http://stakeholders.ofcom.org.uk/consultations/872_876_mhz/>Ofcom published an update on this spectrum in February 2010. In light of the progress of CEPT work on the use of this band subsequent to our 2010 update, Ofcom is planning to publish a further document in Q1 2013 which will consider if the UK should seek to release this band in line with the CEPT, for example to enable use of low power, licence exempt, short range devices. It will also consider the potential release of the 870-872 / 915-917 MHz alongside 872-876 MHz / 917-921 MHz if and when management of this is transferred to Ofcom from government.http://stakeholders.ofcom.org.uk/spectrum/spectrum-awards/prospective-awards/ |

**Information received from the UIC WGFM Group:**

This information shows that the planned E-GSM-R is likely to be used at local hotspots such as some metropolitan stations or big shunting sites only in the vast majority of cases. At the present time in mid 2013, it should also be noted that 3GPP has not assigned the Mobile Class Mark (identity for E-GSM-R capability in the GSM protocol for GSM equipment having implemented the E-GSM-R frequencies) and this is not going to happen before the intra-system compatibility impact of E-GSM on E-GSM900, UMTS900 and LTE900 is finally agreed in 3GPP. These on-going studies make it likely that some E-GSM-R base station emission power reduction will be agreed which makes E-GSM-R implementations less economic. In addition, improved radio modules for GSM-R are specified in ETSI and likely taken over into the interoperability specifications agreed at the ERA for the GSM-R core band (but not covering the E-GSM-R frequencies).

According to latest information in 03/2013, collected in ETSI TC RT in ETSI TR 103 134, GSM-R (voice and data bearer) is deployed and covers around 68 000 km of tracks in Europe and this approximate figure is confirmed by the answers received in response to this questionnaire. In Europe, where the total railway network taken into account is 221 025 km, GSM-R coverage was planned for 149 673 km according to ETSI TR 102 627, published in 11/2008, also explaining that in September 2007 the network comprised 60 507 km equipped with GSM-R infrastructure, of which 40 918 were in operation by that date. This means that GSM-R network implementation has to some extent slowed down in recent years below the figures which have been forecasted about 5 years ago.

The situation set out above makes it at relatively unlikely that widespread implementation of E-GSM-R in Europe will occur.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Land** | **Use Case** | **assigned** | **usage planed** | **not planed** |
| DB (DE) | shunting, Train Radio | x |   |   |
| Network Rail (UK) | shunting, GPRS Monitoring |   | x |   |
| Adif (Spain) | shunting, hot spot coverage etc. |   | x |   |
|  SBB (SUI) | Hot spot coverage |   | x |   |
| ProRail(NL) | shunting, PMR/short range radio, local capacity enhancements for telemetry applications, migration to next generation radio services |   | x |   |
| ÖBB (A) | shunting (yards), coverage of hot spots or disposed application areas |   | x |   |
| Trafikverket(SE) | Possibly to use during and after migration to other technology for the railway |   | x |   |
| FTA(FIN) | shunting, switch-man and train brake testing communications and during the migration period from GSM technology to the next generation radio technology |   |   | x |
| RFF (FR) | plans to use the ER-band in congested or subject to congestion areas, like Paris large railway stations or shunting areas, some important railway nodes etc.  |  | X |  |

Military usage: The NATO JOINT CIVIL AND MILITARY FREQUENCY AGREEMENT (NJFA), defines in the frequency range 790-960 MHz essential military requirements from 10 to 60 MHz for tactical radio relay of which 10 MHz should be harmonised spectrum for training in border areas, subject to bilateral/ multilateral agreements. Furthermore, based on present equipment, the deployment of a Corps-size Reaction Force requires 50 MHz of spectrum, although it is recognised that some countries will have problems fulfilling such a requirement.

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| --- | --- | --- | --- | --- | --- | --- | --- |
|  | **870/915** | **871/916** | **872/917** | **873/918** | **874/919** | **875/920** | **876/921** |
| **Andorra** |  |
| **Albania** |  |
| **Austria** |  | E-GSM-R

|  |  |
| --- | --- |
|  | Not used or going to be unused |
|  | Planned E-GSM-R |
|  | Usage based on PMR/PAMR licences |
|  | Governmental/military usage |

 |
| **Belarus** | ARNS (phased out) |  |
| **Belgium** |  | E-GSM-R |
| **Bosnia Herzegov.** |  |
| **Bulgaria** |  |
| **Croatia** |  | E-GSM-R planned, however GSM-R not deployed in GSM-R core band yet. |
| **Cyprus** |  |  |
| **Czech Republic** |  | Usage terminated |
| **Denmark** |  |
| **Estonia** |  |
| **Finland** | Governmental use terminates |
| **France** |  |
| **Georgia** | 870-876: CDMA-850 Network, 915-921 possible for SRD/RFID |
| **Germany** |  | E-GSM-R |
| **Greece** |  |
| **Hungary** |  | E-GSM-R planned, however deployment in GSM-R core band still in planning phase |
| **Iceland** | Limited p-t-p links, time-limited |
| **Ireland** |  |
| **Italy** |  |
| **Latvia** |  |
| **Liechtenstein** |  | E-GSM-R |
| **Lithuania** |  |
| **Luxemburg** | Request for Smart Metering |
| **FYROM** |  | E-GSM-R 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 Federation** | RFID 916-921 MHz, (ARNS phased out), satellite TTC |
| **Serbia** | Medium term plan to move from defense systems to PMR/PAMR |
| **Slovak Republic** |  | CDMA Network |
| **Slovenia** |  |  |
| **Spain** | 4 **local** licenses for M2M, Metering based  |
| **Sweden** |  |
| **Switzerland** |  | E-GSM-R |
| **The Netherlands** |  |
| **Turkey** |  |
| **Ukraine** | CDMA-800 systems, (deadline of technology usage – 1st January, 2016) |
| **UK** | Plus Wind Profiler (a site) and unused military allocation  |

**The result may lead to a situation where many administration may have a spectrum usage opportunity for secondary applications in the band, however, some may not have in all or parts of the bands, mainly due to the unlimited in time military/governmental usage. A possible outcome after finalisation of the compatibility studies could therefore be to have entries in ERC REC 70-03 which could be implemented by administrations for those frequency opportunities where no military/governmental usage occurs.**

**Based on the preliminary indications from PT SE24 as well as the spectrum inventory information collected by means of the questionnaire for the bands 870-876/915-921 MHz, SRD/MG works on the basis of facing three different situations in the CEPT:**

**1. Some countries where all or parts of the bands could be used by SRD with rather simple spectrum access due to the underused or unused band situation,**

**2. In some countries, more sophisticated spectrum access is needed (e.g. E-GSM-R protection),**

**3. In some countries all or parts of the bands are used by governmental, mostly military usage. In some of these countries, this might be seen even as use on exclusive basis.**

**It is therefore necessary to keep the flexibility in the approach at the moment, and to avoid spectrum fragmentation by dividing spectrum over different applications. On the other side, some split may be unavoidable, also because there are applications needing a more predictable sharing environment than others.**

1. Draft Proposals for ERC Rec 70-03

ERC Rec 70-03 Annex 1

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **g5b-band d) new standard required5** | 870.0-875.8 MHz | ≤ 500 mW e.r.p. | ≤ 2.5% duty cycle and APC required (note 8)For ER-GSM protection, the duty cycle is limited to < 0.01% and a maximum single transmitter on time of 5ms/1s. | ≤ 200 kHz |  | Network infrastructure SRD.The Automatic Power Control for transmitters with 500 mW e.r.p. has a dynamic range of at least 20 dB.The frequency band is also identified in Annexes 2 and 5 |
| **g6** | 870.0-875.9 MHz | ≤ 25 mW e.r.p. | ≤ 1% duty cycleFor ER-GSM protection, the duty cycle is limited to < 0.01% and a maximum single transmitter on time of 5ms/1s. | ≤ 600 kHz |  | The frequency band is also identified in Annexes 2 and 5 |
| **g7** | 875.900-876.000 MHz | ≤ 25 mW e.r.p. | ≤ 0.1% duty cycleFor ER-GSM protection, the duty cycle is limited to < 0.01% and a maximum single transmitter on time of 5ms/1s. |  |  | The frequency band is also identified in Annex 2 |
| **g8** | 915.000-915.300 MHz | ≤ 25 mW e.r.p. | ≤ 0.1% duty cycle |  |  |  |
| **g9** | 915.300-920.9 MHz | ≤ 25 mW e.r.p. | ≤ 1% duty cycle except for the 4 channels identified in (note 9). For ER-GSM protection, the duty cycle is limited to < 0.01% and a maximum single transmitter on-time of 5ms/1s. | ≤ 600 kHz |  | The frequency band is also identified in Annexes 10 and 11 |
| **g****10** | 920.900-921.000 MHz | ≤ 100 mW e.r.p. | ≤ 0.1% duty cycleFor ER-GSM protection, the duty cycle is limited to < 0.01% and a maximum single transmitter on-time of 5ms/1s. |  |  |  |

Notes;

Note 8: a duty cycle of up to 10% may be allowed for infrastructure network access points forming part of metropolitan area networks such as for utilities or other applications. Network access points with such duty cycles from different providers in the same metropolitan area may need to be registered at the national regulatory authority and should be ccoordinated amongst the providers as outlined in Appendix 4.

Note 9: Channel centre frequencies are 916.3 MHz + (1.2 MHz \* channel number). The channel numbers are 0 to 3. The channel bandwidth is 400 kHz. The duty cycle is limited for these channels to ≤ 0.1% duty cycle.

Frequency issues

Subbands g5) to g10)

Use of all or part of sub-bands g5 to g10 may be denied in some European countries that use all or part of these sub-bands for defense/governmental systems. In other countries that use sub-bands 873-876/918-921 MHz for GSM for railways, extended band (ER-GSM), access to the part 873-876/918-921 MHz by non-specific SRD applications requires implementing additional mitigation measures such as transmission timing limitations as set out in ECC Report 200. See Appendix 3 for national implementation concerning ER-GSM and defense/governmental services.

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.

ERC Rec 70-03 Annex 2

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **d** | 870-876 MHz | 25 mW e.r.p. | < 0.1% duty cycleFor ER-GSM protection, the duty cycle is limited to < 0.01% and a maximum single transmitter on-time of 5ms/1s. | Max 200 kHz |  | Meter ReadingThis frequency band is also identified in Annexes 1 and 5 |

**Frequency issues**

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 defense/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 requires implementing additional mitigation measures such as transmission timing limitations as set out in ECC Report 200. See Appendix 3 for national implementation concerning ER-GSM and defense/governmental services.

ERC Rec 70-03 Annex 5

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **new** | 870.000-875.900 MHz | 500 mW e.r.p100 mW e.r.p. | < 0.1% duty cycle and APC requiredFor ER-GSM protection, the duty cycle is limited to < 0.01% and a maximum single transmitter on-time of 5ms/1s. | Up to 500 kHz |  | 500 mW restricted to vehicle-to-vehicle applications.The Automatic Power Control for transmitters with 500 mW e.r.p. has a dynamic range of at least 20 dB.The frequency band is also identified in Annexes 1 and 2 |

**Frequency issues**

Use of sub-band (new) may be denied in some European countries that use all or part of this band for defense/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. See Appendix 3 for national implementation concerning ER-GSM and defense/governmental services.

ERC Rec 70-03 Annex 10

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **c1** | 915.0-921.0 MHz(Note 1) | 10 mW e.r.p. | < 25 % duty cycle | Up to 400 kHz |  | Digital Assistive Listening Device systemsThe frequency band is also identified in Annexes 1 and 11. |

**Frequency Issues**

Sub-band c1):

Channel centre frequencies are 916.3 MHz + (1.2 MHz \* channel number). The channel numbers are 0 to 3.

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 defense/governmental systems or, in some countries that use sub-band 918-921 MHz for GSM for railways, extended band (ER-GSM). See Appendix 3 for national implementation concerning ER-GSM and defense/governmental services.

ERC Rec 70-03 Annex 11

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **c** | 915.0-921.0 MHz | 4 W e.r.p. |  (Note 1)For ER-GSM protection, DAA is required | 400 kHz |  | The frequency band is also identified in Annexes 1 and 10. |

Note 1: operation only when necessary to perform the intended operation, i.e. when RFID tags are present.

Frequency Issues

Sub-band c):

Interrogator channel centre frequencies are 916.3 MHz, 917.5 MHz, 918.7 MHz and 919.9 MHz. There are 14 channels each of 400 kHz. The interrogator transmits on channels 3, 6, 9, and 12. The tag responds on channels 1, 2, 4 ,5, 7, 8, 10, 11, 13, and 14.

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 defense/governmental systems. In other countries that use sub-band 918-921 MHz for GSM for railways, extended band (ER-GSM), access to the part 918-921 MHz MHz by UHF RFID applications require implementing additional mitigation measures such as Detect-And-Avoid (DAA) as set out in ECC Report 200. See Appendix 3 for national implementation concerning ER-GSM and defense/governmental services.

An interrogator may transmit simultaneously in both sub-band b and sub-band c..

1. List of reference
2. Reference one (style: reference)
3. TR 102 791 **Short Range Devices (SRD);Technical characteristics of wireless aids forhearing impaired people operating in the VHF and UHF frequency range**
4. Reference two
5. Etc.
1. They are a loop of cable around a designated area, usually a room or a building, which generates a magnetic field picked up by a [hearing aid](http://en.wikipedia.org/wiki/Hearing_aid#Telecoil). The benefit is that it allows the sound source of interest - whether a musical performance or a ticket taker's side of the conversation - to be transmitted to the hearing-impaired listener clearly and free of other distracting noise in the environment. Typical installation sites would include concert halls, ticket kiosks, high-traffic public buildings (for [PA](http://en.wikipedia.org/wiki/Public_address) announcements), auditoriums, places of worship, and homes. In the United Kingdom, as an aid for disability, their provision where reasonably possible is required by the [Disability Discrimination Act 1995](http://en.wikipedia.org/wiki/Disability_Discrimination_Act_1995), and they are available in "the back seats of all London taxis, which have a little microphone embedded in the dashboard in front of the driver; at 18,000 post offices in the U.K.; at most churches and cathedrals". [↑](#footnote-ref-1)
2. http://www.erodocdb.dk/Docs/doc98/official/pdf/ECCREP182.PDF [↑](#footnote-ref-2)
3. The requirements for Automotive family of SRDs may need revision, noting the currently discussed draft revision of TR 102 649, where Automotive applications, such as Vehicle-to-Vehicle communications may require up to 500 mW transmit power and up to 1 MHz channel bandwidth, with TPC mitigation technique [↑](#footnote-ref-3)
4. The analysis presented in proves that, with simple power sensing on the candidate operational frequency, DAA may only work with very low detection threshold values (in some cases below the noise floor) or for high SNR margins at the victim link receiver. The situation would be improved if the SRD could monitor the emission at the same position where the victim receiver is located. However this would require knowledge about the TRR/UAS duplexing and channel arrangement which cannot be generally assumed. Therefore DAA as a method of operation is not very promising for the protection of TRR and UAS links. Note that due to very low threshold levels DAA may only be possible in cases with prior knowledge of the TRR frequency plan (TDD or FDD with dual band sensing). [↑](#footnote-ref-9)
5. http://www.erodocdb.dk/Docs/doc98/official/pdf/CEPTREP014.PDF [↑](#footnote-ref-10)
6. It should be borne in mind that public announcements in noisy sites involve both distortion of the PA and echo, resulting in a major lack of clarity to the hearer. Delivery of this information via an ALD located in the ear canal delivers intelligible information to the user [↑](#footnote-ref-11)
7. http://stakeholders.ofcom.org.uk/market-data-research/other/technology-research/research/emerging-tech/mesh/ [↑](#footnote-ref-12)