ETSI TR 102 664 V1.1.1 (2009-04)

Technical Report

Electromagnetic compatibility and Radio spectrum Matters (ERM); Road Transport and Traffic Telematics (RTTT); Short range radar to be used in the 24 GHz to 29 GHz band; System Reference Document

Reference
DTR/ERM-024

Keywords
EHF, radar, radio, RTTT, short range, SRD, SRDOC, UWB

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Sous-Préfecture de Grasse (06) N° 7803/88

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Foreword

This Technical Report (TR) has been produced by ETSI Technical Committee Electromagnetic compatibility and Radio spectrum Matters (ERM).

The present document includes necessary information to support the co-operation under the MoU between ETSI and the Electronic Communications Committee (ECC) of the European Conference of Postal and Telecommunications Administrations (CEPT).

Introduction

Over the past years, the industry has responded to European Commission programs and has developed new Short Range Radar (SRR) solutions for Road Safety and Intelligent Transport Systems. This is in support of such programs as *e*Safety, IST, the EU Approach to Road Safety and Intelligent Transport systems (ITS).

European programs funded by the Community made use of SRR technology, for instance the PREVENT projects as INSAFE, COMPOSE and APALACI [i.3]. See http://www.prevent-ip.org/. The FP7 programme continues to consider these SRR technologies as basis for next generation applications [i.16].

The objective and focus of "The EU Approach to Road Safety and Intelligent Transport systems (ITS)", Intelligent Vehicle Systems are defined as to "Improve Safety, Security, Comfort and Efficiency in all Transport modes" and "Focusing on Advanced Pilot/Driver Assistance Systems (in support of vision, alertness, manoeuvring, automated driving compliance with the regulations, etc.)".

The current regulation 2005/50/EC [i.1] is focused on SRRs operating at 24 GHz. At its 24th meeting, the Radio Spectrum Committee discussed part 2.2 of the 2005/50/EC [i.1] on SRR in the 24 GHz range i.e. to review the EC decision by latest 2009:

"2. In addition to the review process in paragraph 1, a fundamental review shall be carried out by 31 December 2009 at the latest to verify the continuing relevance of the initial assumptions concerning the operation of automotive short range radar in the 24 GHz range radio spectrum band, as well as to verify whether the development of automotive short-range radar technology in the 79 GHz range is progressing in such a way as to ensure that automotive short range radar applications operating in this radio spectrum band will be readily available by 1 July 2013".

The present document is related to one of the basic elements of the IST program for the automotive sector and is the base for a variety of SRR applications. The program as established in the present document is needed to enable and further to accelerate the proliferation of Short Range Radar (SRR) under the eSafety program of the EU Commission. The SRR technology otherwise risks to stagnate or to be discontinued. This is because most of the automotive OEMs noted that new SRR product introduction cannot be justified for the introduction of new car lines in view of the 2013 deadline for the 24 GHz band while the introduction of the 79 GHz SRRs is tied to the readiness of the technology which is still under development for mass market introduction.

The present document is created with the goal to enhance the process of introducing the SRRs to the extent that the automotive SRR technology is used in a higher %age of cars allowing the effective enhancement of safety on the roads. The most recent report to the Commission on car penetration with SRRs shows that after three years after the production start and release of the 24 GHz regulation, the car fleet penetration has only reached very low level of 0,01 % with no outlook to increase significantly further [i.13].

Considering the foregoing, the RSCOM document 08_24, "*Third Party document - Request to initiate fundamental review of automotive short-range radar equipment operating in the 24 GHz radio spectrum band* " [i.14], indicates that members can testify that the consumer acceptance of 24 GHz SRR is high when the option is offered, but only few automotive manufacturers have offered this option and those that presently do, are reconsidering whether to implement it in upcoming model lines.

The recent RSCOM #25 meeting provided a working document for the revision of the of the EC Decision 2005/50/EC [i.1] to define the conditions, as ToRs for the task and the Mandate to CEPT including the timescale and the deliverables by the ECC fundamental review of EC Decision 2005/50/EC [i.1] on the use of the 24 GHz band by automotive short-range radar applications (SRR) [i.6].

1 Scope

The present document provides a proposal for a complementary introduction of a 24 GHz to 29 GHz UWB SRR technology that is supposed to overcome the challenges experienced under the existing regulation.

It is to be noted that the existing regulation for 24 GHz as well as for 79 GHz is not intended to be modified but to be complemented by this new option.

The present document applies to Short Range Devices for automotive applications as defined by EC Decisions 2005/50/EC [i.1] and 2004/545/EC [i.7]. It considers the previous SRDoc TR 102 982 [i.11], reviews the present regulation for the 24 GHz UWB SRR band, analyses the situation in the automotive and the component supplier industry, addresses cost issues, the market penetration and regulatory shortcomings. Secondly it proposes forward looking solutions to improve the regulatory situation in order to allow a deployment of cars on the road, the global harmonization of SRRs, a more efficient contribution of the SRR technology to the road safety needed to comply with the goals of the eSafety program of the European Commission [i.8].

The present document includes the necessary information to support the co-operation between ETSI and the ECC of the CEPT including:

- Detailed market information (annex A).
- Technical information (annex B).
- Expected compatibility issues (annex C).

2 References

References are either specific (identified by date of publication and/or edition number or version number) or non-specific.

- For a specific reference, subsequent revisions do not apply.
- Non-specific reference may be made only to a complete document or a part thereof and only in the following cases:
  - if it is accepted that it will be possible to use all future changes of the referenced document for the purposes of the referring document;
  - for informative references.

Referenced documents which are not found to be publicly available in the expected location might be found at http://docbox.etsi.org/Reference.

NOTE: While any hyperlinks included in this clause were valid at the time of publication ETSI cannot guarantee their long term validity.

2.1 Normative references

The following referenced documents are indispensable for the application of the present document. For dated references, only the edition cited applies. For non-specific references, the latest edition of the referenced document (including any amendments) applies.

Not applicable.

2.2 Informative references

The following referenced documents are not essential to the use of the present document but they assist the user with regard to a particular subject area**.** For non-specific references, the latest version of the referenced document (including any amendments) applies.

[i.1] EC Decision 2005/50/EC of 11 August 2005 on the reclassification of hip, knee and shoulder joint replacements in the framework of Council Directive 93/42/EEC concerning medical devices.

[i.2] ETSI EN 300 440:

[i.3] PREVENT projects as INSAFE, COMPOSE and APALACI.

NOTE: Available at http://www.prevent-ip.org/.

[i.4] ETSI EN 302 264:

[i.5] RSCOM#24, Item 12: "Third Party document, Request to initiate fundamental review of automotive short-range radar equipment operating in the 24 GHz radio spectrum band".

[i.6] RSCOM08-71: "Fundamental review of EC Decision 2005/50/EC on the use of the 24 GHz band by automotive short-range radar applications (SRR)".

[i.7] Commission Decision of 8 July 2004 on the harmonisation of radio spectrum in the 79 GHz range for the use of automotive short-range radar equipment in the Community.

[i.8] EC SPEECH/02/181: "Towards a comprehensive eSafety Action Plan for improving road safety in Europe", High level meeting on Safety Brussels 25 April 2002, Erkki Liikanen.

[i.9] ETSI EN 302 288-1(V1.4.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices; Road Transport and Traffic Telematics (RTTT); Short range radar equipment operating in the 24 GHz range; Part 1: Technical requirements and methods of measurement".

[i.10] ECC Report #23: "Compatibility of automotive collision warning, short range radar operating at 24 GHz with FS,EESS and Radio Astronomy".

[i.11] ETSI TR 101 982: "Radio equipment to be used in the 24 GHz band; System Reference Document for automotive collision warning Short Range Radar".

[i.12] ITU-R Recommendation SM.1756: "Framework for the introduction of devices using ultra-wideband technology".

[i.13] RSCOM08-51: "Automotive short-range radars: third annual SRR report and request by SARA to review the EC Decision on the use of the 24 GHz band by SRR".

[i.14] ECC/DEC/(04)10: "ECC Decision of 12 November 2004 on the frequency bands to be designated for the temporary introduction of Automotive Short Range Radars".

[i.15] Viviane Reding, Speech/08/: "Choose ESC, Choose life".

NOTE: See http://ec.europa.eu/information_society/activities/esafety/doc/2008/choose_esc_speech_vr.pdf.

[i.16] Seventh Research Framework Programme [FP7].

NOTE: Available at http://cordis.europa.eu/fp7/info-programmes_en.html.

[i.17] ETSI EN 301 091 (parts 1 and 2): "Electromagnetic compatibility and Radio spectrum Matters (ERM);Short Range Devices; Road Transport and Traffic Telematics (RTTT); Radar equipment operating in the 76 GHz to 77 GHz range".

[i.18] Mercedes Benz Press Information (June 2008): "20% fewer rear-end collisions thanks to DISTRONIC PLUS and Brake ASSIST PLUS".

[i.19] Bundesanstalt für Strassenwesen (BAST): "Volkswirtschaftliche Kosten der Personenschäden im Strassenverkehr", Publication of BAST, Issue M102, January 1999, Authors Herbert Baum, K-J Höhnscheid, University of Cologne.

[i.20] ECC Report 46 (May 2004): "Immunity of 24 GHz automotive SRRs operating on non interference and non-protected basis from emissions of the primary Fixed Service operating in the 23 GHz and 26 GHz frequency bands".

[i.21] ERC Report 25: "European Common Allocation Table (ECA)".

[i.22] ERC Recommendation 74-01: "Unwanted emissions in the spurious domain".

[i.23] ITU-R Recommendation SM1757: "Impact of devices using ultra-wideband technology on systems operating within radiocommunication services".

[i.24] CEPT/REC 70-03:" Relating to the Use of Short Range Devices (SRD)".

[i.25] Commission Directive 2005/50/EC of 11 August 2005 on the reclassification of hip, knee and shoulder joint replacements in the framework of Council Directive 93/42/EEC concerning medical devices

[i.26] CEPT/ECC Decision DEC(02)01: "ECC Decision of 15 March 2002 on the frequency bands to be designated for the coordinated introduction of Road Transport and Traffic Telematic Systems"

[i.27] Commission Decision 2004/545/EC of July 2004 on the harmonisation of radio spectrum in the 79 GHz range for the use of automotive short-range radar equipment in the Community.

3 Definitions, symbols and abbreviations

3.1 Definitions

For the purposes of the present document, the following terms and definitions apply:

bandwidth: range of frequencies, expressed in Hertz (Hz), that can pass over a given transmission channel

frequency allocation (of a frequency band): entry in the Table of Frequency Allocations of a given frequency band for the purpose of its use by one or more terrestrial or space **radiocommunication services** or the **radio astronomy service** under specified conditions

Industrial Scientific and Medical bands (ISM): frequency bands in which non-radio RF emissions can be allocated

narrowband: classification for the spectral width of a transmission system

occupied bandwidth: bandwidth of an emission defined for UWB or alike systems as 10 dB bandwidth of the power spectral density

Power Spectral Density (dBm/Hz) (PSD): ratio of the amount of power to the used radio measurement bandwidth

NOTE: It is expressed in units of dBm/Hz or as a power in unit dBm with respect to the used bandwidth. In case of measurement with a spectrum analyser the measurement bandwidth is equal to the RBW.

Pseudo Noise (PN): digital signal with noise-like properties

resolution: degree to which a measurement can be determined is called the resolution of the measurement

separation: capability to discriminate two different events (e.g. two frequencies in spectrum or two targets over range)

Spread Spectrum (SS): modulation technique in which the energy of a transmitted signal is spread throughout a larger frequency range

ultra wideband: classification for the spectral width of a transmission system

wideband: classification for the spectral width of a transmission system

3.2 Symbols

For the purposes of the present document, the following symbols apply:

ΔR	Range separation
dBm	Decibel, milliwatt
f	Frequency
P	Power
R	Distance

3.3 Abbreviations

For the purposes of the present document, the following abbreviations apply:

ACC	Automotive Cruise Control
BPSK	Binary Phase Shift Keying
ECC	Electronic Communications Committee
EESS	Environmental Earth System Science
FCC	Federal Communications Commission
FMCW	Frequency Modulated Continuous Wave
ISM	Industrial Scientific, Medical
IST	Information Society Technologies
KBA	Kraftfahrt-Bundesamt (Germany)
LRR	Long Range Radar
OEM	Original Equipment Manufacturer
PN	Pseudo Noise
PSD	Power Spectral Density (dBm/Hz)
RF	Radio Frequency
SRD	Short Range Device
SRR	Short Range Radar
SS	Spread Spectrum
ToR	Terms of Reference
UWB	Ultra Wide Band

4 Comments on the System Reference Document

Administrations (Austria, Switzerland, France, Finland) expressed, in the ETSI ERM#36 meeting, strong concerns about the introduced frequency band 24 GHz to 29 GHz for UWB SRR due to the fact that for the time being fixed links are extensively used in parts of the above frequency range. Furthermore part of the above frequency range is as well used by military (NATO) organizations.

Orange/FT noted also that the frequency band to be considered is expected to be heavily used by Fixed Links (and also by communications systems involving satellites).

It is expected that this view is shared by several other telecommunication operators.

5 Executive summary

5.1 Background information

The experience with 24 GHz UWB SRR development and the deployment over the past 3 to 5 years based on existing regulations [i.1], [i.14] and [i.9] have shown that the goals of the eSafety program of the EU cannot be met.

The main reasons are as follows:

1) The deadline of 2013 has been experienced as a major barrier for most car-makers and de-facto prohibits the expected widespread SRR implementation in their car lines, which was the basis for the deadline.

2) The global harmonization of the 24 GHz SRR range as defined in the EC Decision [i.1] is not achievable as various contacts with many other worldwide administrations have shown, while the proposed 26,5 GHz SRR UWB range can be globally harmonized right now.

3) The automatic deactivation has caused significant implementation issues for middle and low class cars.

4) It can be expected that cost-effective 79 GHz SRR technology may not be available for seamless transition by 2013. The challenge is now even greater due to the unexpected low deployment of 24 GHz SRRs on the European markets which is approximately 0,01 % instead of the initially forecast of about 2 % for end of 2008.

5) A much higher SRR penetration rate is also a prerequisite to the 79 GHz SRR implementation which is not possible with the present regulation.

6) The combination of the 24 GHz cut-off date and the non-availability of 79 GHz worldwide is a major obstacle for adoption of SRR in the market place.

7) Another challenge is the long development and production timelines in the automotive industry for which the current regulation is experienced to be insufficient.

8) There is an increasing risk that the UWB SRR technology may not be continued because of the lack of business cases. This is despite the fact that UWB SRR technology is superior, more robust and efficient than other safety and collision mitigation technologies.

In consequence, the present document provides a proposal for a complementary introduction of a 24 GHz to 29 GHz SRR technology that with the addition of technical and operational characteristics more favourable than those assumed for developing ECC/REPORT 23 [i.10], is supposed to overcome the above depicted challenges. It is to be noted that the existing regulation for UWB SRRs for 24 GHz and 79 GHz is not intended to be modified but to be complemented by this new option.

The proposal is expected to be the only solution that fosters the implementation of the 79 GHz SRR technology in the market (see item 7 above). The 79 GHz SRR technology itself provides significant design advantages (e.g. size, performance, a combined ACC/SRR platform) and will therefore definitely be the long term choice for SRR applications under the precondition that a rather large SRR market already exists in Europe for gradually shifting to 79 GHz.

The proposal has also become feasible by the evolution of SRR UWB technology allowing the design of SRR products which do not need the use of the 24 GHz ISM band for the carrier emission. The proposal avoids the 23,6 GHz to 24 GHz band covered by RR footnote 5.340 for Radio Astronomy Service and the Earth Exploration Satellite Service.

The existing EC Decision 2005/50/EC of 17 January 2005 (published in OJ L 21 of 25 January 2005, p. 15) [i.1] requests a fundamental review of the SRR regulatory situation to be completed before end of 2009. A mandate from RSCOM to CEPT ECC is available. The proposal covered in the present document is requested to be considered as input document for this review process requesting further studies.

5.2 Technical information

The present 24 GHz SRR products rely on UWB modulation and necessitate the emission of the UWB modulated residual carrier signal which is approximately 20 dB higher than the UWB emission levels.

Recent SRR modulation techniques and SRR design techniques avoid the carrier emission beyond the UWB signal level and therefore can move outside the ISM band with the centre frequency of the UWB SRR signals.

This allows the SRR UWB signal to avoid the protected bands for passive services as defined in RR No. 5.340 of the radio regulation of 23,6 GHz to 24 GHz such as Radio Astronomy and EESS therefore giving full protection from the SRR UWB emissions. The 24 GHz to 29 GHz range is recommended, pending compatibility studies for the services affected. In addition, the experience made on current production of 24 GHz SRR permits an up-dating of the technical and operational characteristics with respect to the preliminary assumptions made for ECC/REPORT 23 [i.10], therefore it is expected that also the coexistence with FS systems in bands 26 GHz and 28 GHz can be solved.

The present regulation requires the incorporation of a SRR automatic deactivation mechanism to be activated in the vicinity of some 23 European locations where radio astronomy sites exist. This function requires additional non-SRR inherent circuitry for the control function [i.1], [i.14] and [i.9] which adds significant cost to the SRR modules.

This requested review of regulation and change of allocation is also in line with the ITU-R goal of global harmonization of frequencies for SRRs. In the case of SRRs the harmonized operating range is set for the range of 24 GHz to 29 GHz.

More detailed information is given in annex B.

5.3 Market information

5.3.1 Automotive radar technologies.

Automotive radar function covers Long Range Radar (LRR) and Short Range Radar (SRR). The eSafety functions and goals cover Long Range Radar (LRR) at 77 GHz as well as SRRs.

LRR is used for distance scanning, which requires an operating range of approximately 150 m and is used at vehicle velocities above 30 km/h to 50 km/h. One or multiple forward looking narrow beams control or scan the driving path in front of the car to determine the distance to the vehicle driving ahead for maintaining a constant minimum safety distance (see EN 301 091 [i.17]). The maximum bandwidth of LRR devices is below 1 GHz corresponding to a typical spatial resolution of 1 m.

SRR units presently operate at 24 GHz and provide an operating range of approximately 30 metres. They are used for a number of different applications to enhance the active and passive safety. Such applications include obstacle avoidance, collision warning, pre-crash, lane change warning, lane change aid, blind spot detection, parking aid and airbag arming. The bandwidth is below 5 GHz corresponding to a spatial resolution capability of ~ 10 centimetres.

For optimal function of collision avoidance, both technologies will be needed.

Only the UWB SRR technology provide the "surround looking" capability as well as the high resolution for detecting various objects at a distance which is needed for the *e*Safety requirements. Therefore SRRs allow a significant increase in safety, resulting in the saving of lives and avoiding damage of goods which is in the order of hundreds of Billion EUR/per annum [i.11] and [i.18].

24 GHz as well as the proposed 24 GHz to 29 GHz SRR technology allows a low-cost design and keeps the product size small enough to fit the sensor in the space given behind vehicle bumper fascias. Transmission of mmWaves through painted fascia material is feasible. Low cost is a pre-requisite for the use in mid-range class and low class cars. Therefore and because of their potential for high market penetration it can significantly contribute to road safety.

5.3.2 Automotive SRR evolution, penetration and functionality

Development of automotive safety systems for collision mitigation has the goal to gain time to react and prepare a car in case that a crash might occur. A first step hereto was ESC (Electronic Stability Control), which observes the behaviour of the own car. The SRR technology allows observation of the objects or obstacles in the vehicle surrounding to actuate preventive measures e.g. controlled airbag firing, seatbelt and seat adjustments and adaptive breaking. A further development of the automotive safety technology will be Car-to-X Communication.

The benefit of SRR collision avoidance compared to other automotive safety technologies is that enhanced safety on the roads is given and even more effective with lower penetration as compared to other safety systems which in some cases require the functioning of a safety system or rely on similar installation in other cars.

Therefore the safety is enhanced with each additional car equipped with SRR, while other systems rely on higher penetration levels for comparable effects.

Nevertheless the penetration of SRR cars is vital for collision mitigation or avoidance and is a key technology for eSafety. The actual penetration analysis of the third annual report of the automotive industry which is based on the official KBA Report of June 2008 [i.13] states a low penetration of 0,01 %.

What is more alarming and significant for the stall of the contribution of SRRs to road safety, is the fact that the raise of penetration from the preceding 2007 report to the 2008 records is only 0,002 %age points which signals that the penetration stagnates for the coming years because of the approaching 2013 deadline.

The acceptance of the SRR by the market (where offered) was noted to be high [i.13] however the very low penetration is a result of the very limited offering of SRR technology by manufacturers and only offered for the top of the car line models. This is in contrast to the low cost potential of the 24 GHz SRR technology. The reason behind is that the automotive manufacturers do not see a business case for new SRR car developments for the short remaining time window of the current frequency regulation in Europe.

Since the 79 GHz technology is not yet mature for a one-by-one replacement of the car lines and with a production start around 2010, the transition from the 24 GHz technology to 79 GHz cannot happen as foreseen. This roots back to the reasons stated above which led to a more or less total blocking of 24 GHz SRR market proliferation in Europe, being the most important prerequisite to open the market also for 79 GHz next generation systems.

5.3.3 Outlook

The implementation of the proposal of the present document for the frequency range of 24 GHz to 29 GHz will remedy the shortcomings of the present market situation.

The advantage of the new approach is that the technology step from 24,15 GHz ±2,5 GHz to 24 GHz to 29 GHz is a small step compared to 79 GHz. No major costs qualifications and major timely delays are encountered, the new system can be deployed in a reasonable short time window with the result to accelerate the SRR car penetration significantly (see figure A.2.1).

In addition the avoidance of emissions into the passive band 23,6 GHz to 24 GHz removes severe regulatory burdens.

The benefits are:

- no time limit - essential for the planning safety for the automotive industry;
- global harmonization, production and deployment of systems;
- a higher level of penetration while preserving the non-interference capability to existing services;
- larger impact on eSafety program;
- lower cost to the car user because of higher production volume;
- the 24 GHz to 29 GHz designs and technology are available and can function as a replacement for the present 24,15 GHz ± 2,5 GHz band SRR modules;
- no car (and bumper) redesign needs to be carried out;
- the ramp-up of the 24 GHz to 29 GHz production bridges the gap to the introduction of the 79 GHz SRR systems;
- no additional circuitry for the SRR deactivation function is needed resulting in less complex systems and lower cost to the user;
- avoids the imminent/pending risk to cancel the SRR technology in the industry because of the stagnation of the present penetration;
- the proposal will establish a SRR market with sufficient volume, a prerequisite to the introduction of 79 GHz.

Independent from the proposed approach, the automotive industry is remaining committed and works intensively on the development of 79 GHz technology because of the potential of performance improvement using the higher frequency technology. In the future both technologies will be on the market if the above preconditions can be achieved. Further details are given in annex B.

6 Technical Radio Spectrum requirements and justification

6.1 Current regulations

6.1.1 SRRs operating in the range of 24,15 GHz ±2,5 GHz and 24,05 GHz to 24,25 GHz

Relevant excerpt of the ECC Decision (04)10 [i.14]:

1) that in order to allow early introduction of SRR applications in Europe the 24 GHz frequency range is designated for SRR systems on a temporary basis as follows:

   a) 24,15 GHz ± 2,5 GHz for the Ultra Wideband component, with a maximum mean power density of -41,3 dBm/MHz e.i.r.p. and peak power density of 0 dBm/50 MHz e.i.r.p;

   b) 24,05 GHz to 24,25 GHz for the narrow-band emission mode/component, which may only consist of an unmodulated carrier, with a maximum peak power of 20 dBm e.i.r.p and a duty cycle limited to 10 % for peak emissions higher than -10 dBm e.i.r.p.

2) that the temporary frequency designation for SRR equipment in the 24 GHz range is on a non-interference and non-protected basis;

3) that emissions within the 23,6 GHz to 24 GHz band that appear 30° or greater above the horizontal plane should be attenuated by at least 25 dB up to 2010 and 30 dB up to 1 July 2013 for SRR systems operating in the 24 GHz range as defined in Decides 2;

4) that 24 GHz SRR systems transmitting in the band 23,6 GHz to 24 GHz with an eirp higher than -74 dBm/MHz or in any band listed in considering ee) with an eirp higher than - 57 dBm/MHz, should be fitted with an automatic deactivation mechanism to ensure protection of Radio Astronomy sites as well as manual deactivation to ensure that emissions are restricted only to those countries that have implemented the temporary solution. In order to allow an early implementation of 24 GHz SRR Systems the automatic deactivation should be made mandatory from 1 July 2007. Before that date, manual deactivation is required;

5) that where an automatic deactivation mechanism is implemented, 24 GHz SRR systems should be de-activated within the specified separation distance from the radio astronomy sites referenced in annex 1.

6.2 Proposed Regulation

The proposed frequency band ranges from 24 GHz to 29 GHz with a maximum average emission level of -41,3 dBm/MHz e.i.r.p. A minimum total bandwidth of 4 GHz is needed as it is also used by the 77 GHz to 81 GHz SRR technology and within the 24 GHz to 29 GHz frequency range. This is required to provide the needed resolution.

The unwanted UWB emissions in the frequency band 23,6 GHz to 24 GHz are proposed to not exceed -74 dBm/MHz e.i.r.p.

The unwanted UWB emissions in the frequency band above 29 GHz and below 23,6 GHz are proposed to not exceed -61,3 dBm/MHz e.i.r.p.

Spurious emissions and out of band emissions below 23,6 GHz and above 29 GHz that are not of UWB character (e.g. from digital circuitry, microprocessors) are pursuant to the limits in ERC Recommendation 74-01 [i.22]. The proposal does not contain any cut-off date or penetration rate limitation. It is complementary to the existing regulation for 24 GHz SRR and 79 GHz SRR which is not proposed to be modified.

7 Main conclusions

The present document describes the need for the proposed allocation of the new SRR frequency range from 24 GHz to 29 GHz.

1) The shortcomings of the present UWB SRR regulation are such that the SRR technology risks discontinuation because of a severe gap between the 2013 deadline of the 24 GHz SRR regulation and the earliest production readiness of the 79 GHz SRR technology.

2) The protection requirements of passive services in the 23,6 GHz to 24 GHz dictate a shift of frequency to a range which is close to the presently used frequency band because of technology availability for short design-in cycles. The proposal is in line with this.

3) The goals of the eSafety of the European commission for safety on the roads are at stake since the SRR car penetration stalls at a low penetration level of 0,01 % with no outlook to increase e.g. over the next 5 years, unless the proposal is fulfilled.

4) The proposal of the present document fulfils the requirement of the EC Decision 2005/50/EC [i.1] for conducting a fundamental review to be completed by 2009. This is in line with the EC draft mandate to the ECC issued for the RSCOM#26.

5) The present document describes a proposal for the anticipated frequency range that eases the introduction of SRRs in the proposed range while protecting the passive services. It presents a cost efficient solution especially avoiding the cumbersome and costly inclusion of deactivation devices around radio astronomy sites.

6) The proposed solution provides the unique option of a global harmonization for UWB SRRs as pursued by the ITU-R during WRC 2007.

7) The industry continues with strong commitment for continued development efforts to productize the 79 GHz SRR technology on the chip and sensor module as well as the assembly technology level for the earliest possible market introduction. The 79 GHz SRR technology provides the optimum performance combined with the synergy option to combine the long range 76 GHz ACC function with the short range surround looking performance in one module (see figure B.1.1 and reference [i.13]).

8 Requested ECC and EC actions

ECC working group FM is requested to study the proposal contained in the present document.

Furthermore, radio compatibility and sharing studies for the verification of potential interference to other services/applications operating in the proposed band are considered to be needed.

The compatibility studies which led to the development of ECC Decision (04)10 [i.14] should be taken into account as far as possible (ECC Reports 23 and 46) [i.10], [i.20].

New information from ITU-R Recommendation SM 1756 [i.12] should also be taken into account.

It is noted that the frequency range 26,5 GHz to 27,5 GHz is a harmonized NATO band type 2 for planned military use (based on allocations for the Fixed and Mobile Service, but without allocation for the Radiolocation Service) according to the NJFA (NATO Joint civil/military Frequency Agreement) and according to ERC Report 25 (The European table of frequency allocations and utilizations in the frequency range 9 kHz to 3 000 GHz) [i.21].

The EC is requested to study the proposal and review of the assumptions and criteria for the ECC report 23 in consideration of the ITU-R recommendations and reports. This may lead to the development of a new EC Decision for SRR within the frequency range 24 GHz to 29 GHz.

ECC is requested to complete their studies by March 2010.

9 Expected ETSI actions

ETSI will provide a Harmonized Standard for the proposed new frequency range considering the outcome of the proposed compatibility studies in ECC WGSE.

Annex A: Detailed market information

A.1 Applications

The UWB SRR technology provides a number of safety and driver convenience functions available within an UWB SRR design as shown in figure A.1 and in the list below. Some individual functions maybe realizable with other technologies but not all listed performance items in a single UWB SRR realization.

Short Range Radar functions:

- Collision warning, collision mitigation, collision avoidance.
- Pre-crash sensing.
- Controlled firing of restraints, airbags.
- Stop and Go.
- Detection of all fixed and moving objects around the vehicle.
- Lane change warning.
- Blind spot detection.
- Parking aid.
- Low speed back-up driving.
- Pedestrian recognition.

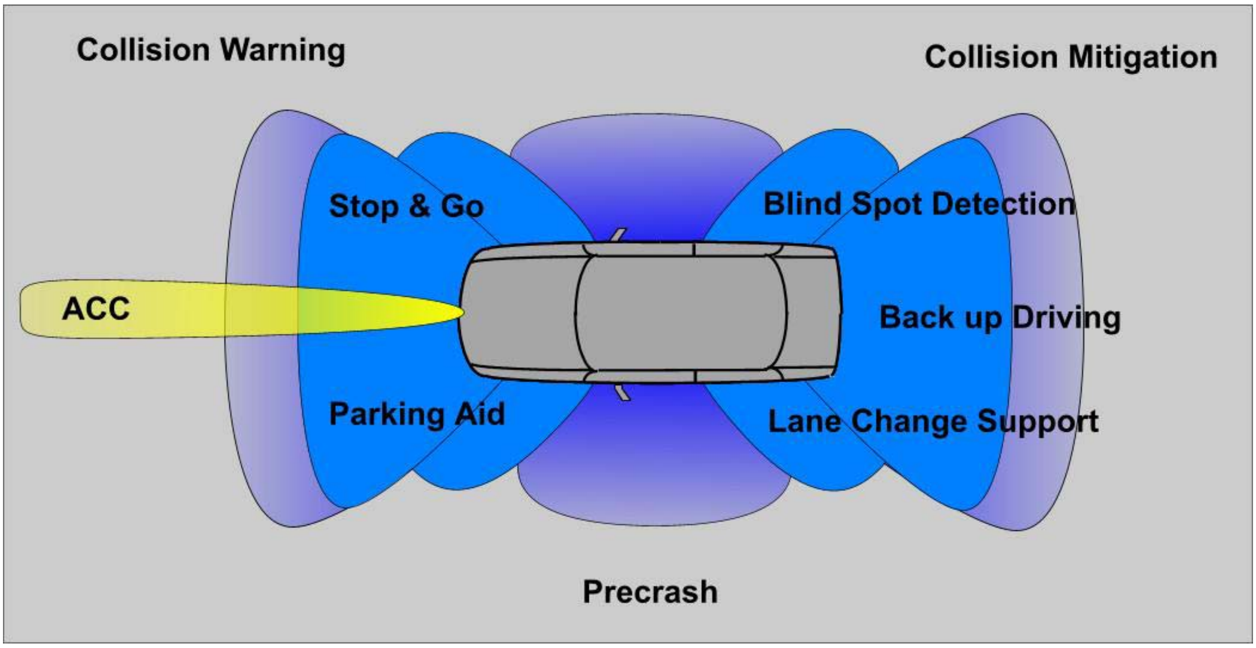

Figure A.1: Short Range Radar Applications and Functions

A.2 Market

A.2.1 Market penetration

Considering three and one-half years of experience in Europe and noting the high interest in eSafety and the consumer acceptance of SRRs, it is apparent that the low take-up of SRR is due to regulatory impediments which prevent the offering of SRR technologies by car manufacturers to consumers.

What has changed since the issuance of the 24 GHz EC and ECC decisions is the fact that the timely availability of a 79 GHz production ready technology was not given. Therefore the transition to 79 GHz failed while at the same time the car manufacturers with their long design and production cycles could not commit to 24 GHz UWB SRRs.

The market penetration curve in Europe is a function of this and stalls at a low level of 0,01 % because of the 2013 deadline proved to be an insurmountable obstacle for committing car manufacturers to 24 GHz SRRs.

Despite strong and good faith efforts to develop alternative technology, [i.13], the 79 GHz technology is not yet a viable technical and economic option for the coming years but remains as an essential part of the roadmap for automotive high performance SRRs.

Meanwhile US automotive OEMs raised the prospect of 4 million to 6 million SRRs being supplied in the USA within the next years; economies of scale would raise market acceptance. The FCC regulation avoids passive band concerns in North America with their regulation which is comparable to the proposal of the present document.

One large US OEM is launching its first car line in 2008 with SRR. However, this OEM will not offer UWB SRR equipped cars in Europe because of the restrictions in current frequency regulations.

The predicted market penetration in the EU will rise similarly to North America if the SRR regulation is amended as proposed in the present document.

According to the figure A.2.1 the market penetration of the different UWB SRR concepts show that considering both UWB SRR technologies of 79 GHz and 24 GHz to 29 GHz the penetration will outperform the projections of North America.

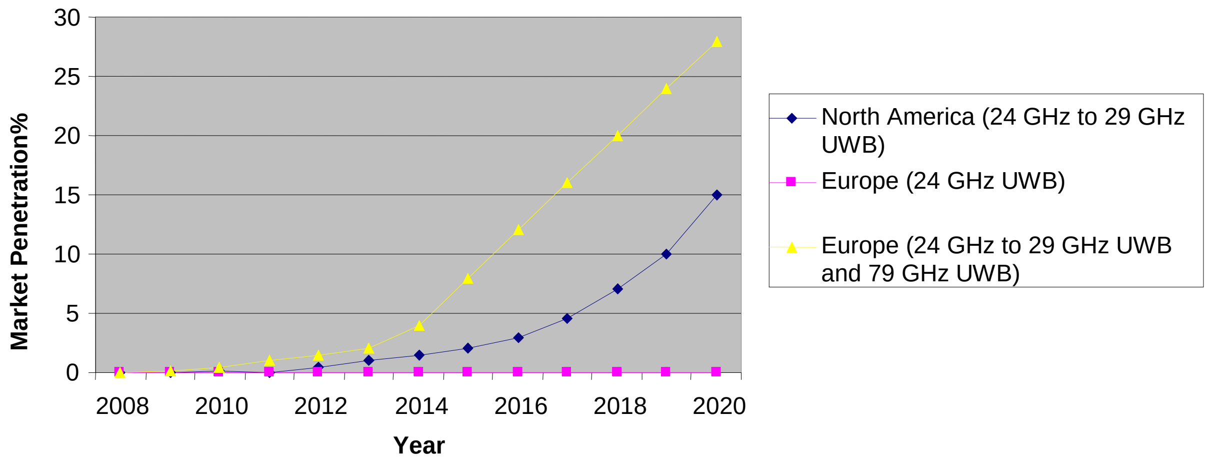

Figure A.2.1: SRR Market Penetration Forecast

A.2.2 Safety contribution and socio-economic benefit

SRR is an enabling technology for enhanced active safety systems and in particular the mitigation of front-end crashes thus reducing damages and saving of lives.

Investigations of the automotive industry were made, which identify the following social economical benefit resulting from road accidents or avoidance thereof (e.g. in Germany ~ 36 billion Euro).

Accidents involving vehicles are related to traffic situations in which a faster reaction of the driver could have avoided crashes. Consequently, there is an increased need and appreciation for obstacle detection systems that operate at day and night.

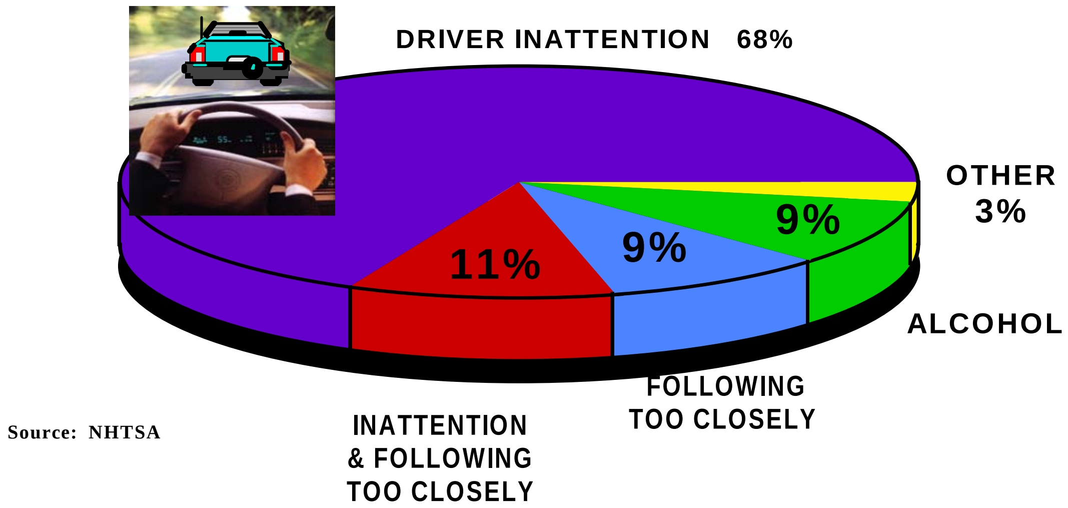

Figure A.2.2: Causes of Rear-Front Crashes

Annual damage cost caused by accidents in the EU is approximately billion EUR 100 which can be potentially avoided or minimized according to analysis given in "Volkswirtschaftliche Kosten der Personenschäden im Strassenverkehr" [i.19].

An accident study [i.18] published by Mercedes-Benz shows that 20 % of all rear end collisions can be avoided. Even more noteworthy, the findings also revealed that on motorways, where the impact of crashes are more severe than on roads, the rear-end collisions can be reduced even further to an average of 36 %.

The findings were based on a new procedure - for the first time it is possible to calculate and predict the usefulness of new safety technologies. Factors taken into account during the research included both official statistics and the analysis of the approximately 16 000 traffic accidents which have so far been studied within the framework GIDAS (German In-Depth Accident Study), as well as the reconstruction of more than 800 rear-end collisions.

Rear end collisions dominate in collision statistics. E.g. in Germany, there are over 50 000 severe rear-end accidents every year, with 5 700 death cases or serious injuries. In the U.S., around 30 % of all traffic accidents are the result of rear-end collisions. Reducing both by 20 % and additionally reducing the severity of an even higher %age, would be a milestone in improving automotive safety.

A.2.3 Global SRR scenario and regulations

Figure A.2.3 displays the different automotive radar systems, the associated standards and regulations for major countries in the ITU regions 1, 2 and 3.

While the 24 GHz UWB SRR is time limited and cannot achieve global harmonization, the proposed new regulation is the potential global solution for all ITU regions for UWB SRRs.

It is also to note that the 79 GHz regulation is to be addressed for regulatory amendments in the US and Canada.

	24 GHz NB Radar	24 GHz UWB SRR	24 GHz to 29 GHz UWB SRR	77 GHz ACC	79 GHz SRR
Europe	EN 300 440 SRD ISM band CEPT/REC 70-03 (see note 1)	EN 302 288 2005/50/EC (see note 2)	EN 302 xxx 2009/xx/EC *(will be issued in 2009 or 2010)*	EN 301 091 CEPT/ECC Decision DEC(02)01 CEPT/REC 70-03	EN 302 264 2004/545/EC
USA	Parts 15.245 (see note 3) and 15.249 (see note 4) general Part 15	Parts 15.515 and 15.252 FCC 02/42 and FCC 04/285	Parts 15.515 and 15.252 FCC 02/42 and FCC 04/285	Part 15.253 general Part 15	not available - will be addressed
Japan	RADIOLOCATION – Unlicensed Low Power Services in Annex 6-3-2-11	24 GHz SRR study started in 12/2006	*The 24 GHz to 29 GHz range is favoured but needs studies*	Low Power Service (millimeterwave radars) in Annex 6-3-2-8	78 GHz to 81 GHz in future frequency allocation plan (see note 5)
Canada	RSS-210	New regulation in final stage RSS-220 in RABC for approval	*New regulation In final stage RSS-220 in RABC for approval*	RSS-210	not available- will be addressed

Color Legend:

Standard for compliance
Decision or legal framework

NOTE 1: Not harmonized in Europe, national restrictions (not Class 1 equipment).
NOTE 2: Time limitation until 2013, then shift to 79 GHz.
NOTE 3: Field Disturbance Sensor band from 24,075 to 24,175 GHz with 32,7 dBm radiated power.
NOTE 4: Any frequency band from 24,00 to 24,25 GHz with 12,7 dBm radiated power.
NOTE 5: http://www.soumu.go.jp/s-news/2006/pdf/061031_3_bt.pdf.

Figure A.2.3: Global SRR regulatory, standard status including proposed SRR regulation

Annex B: Technical information

B.1 Technical description

B.1.1 SRR systems overview

An SRR systems overview and operational parameters with technical descriptions is given in TR 101 982 and in the following links:

- http://ftp.ero.dk/wgse/Se24/SE24_M14_Jan_02_London,/M14_05RO_SE24_24G_System-Tyco.pdf
- http://ftp.ero.dk/wgse/Se24/SE24_M14_Jan_02_London,/M14_14R0_SE24_WI02_01-24GHz_System_SV.pdf

All systems or devices are pursuant to the national regulations regarding peak and average e.i.r.p. power emission of the present regulations.

Due to different regional rule-making or standard implementations, the frequency emission masks can be different in shape and range; i.e. US and Canada do have a box shape type mask from 22 GHz to 29 GHz while Europe and Australia do have a mask that is centred around 24,125 GHz with slopes on both sides [i.9].

Figure B.1.1 provides an overview over the key parameters as Doppler (object distance) resolution, the angle resolution and range or object discrimination resolution.

The comparison shows that SRRs operating at the highest frequency and with high bandwidth provides the best SRR performance.

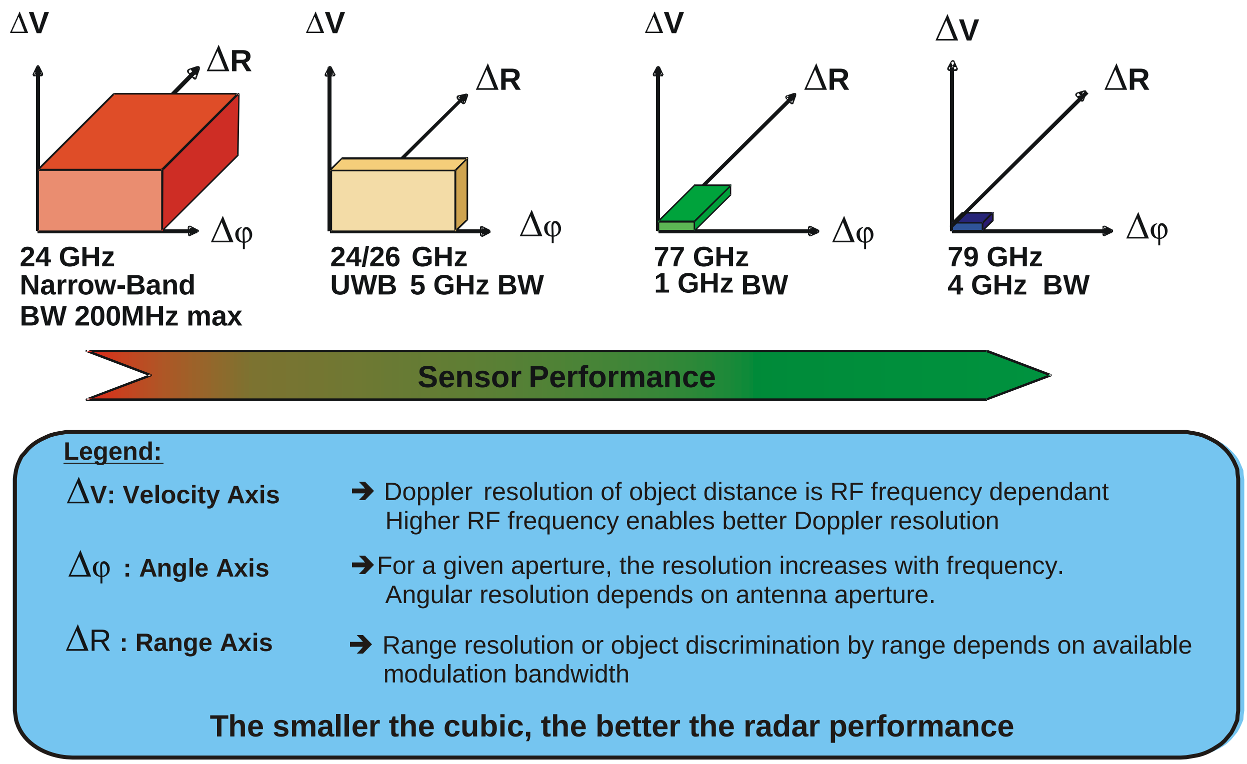

Figure B.1.1: Automotive Radar performance overview and evolution of systems

The 24 GHz narrowband radar uses the higher emission levels of the ISM band, the resolution of objects to be detected is limited by the available frequency bandwidth which is 200 MHz maximum. In order to provide the same functionality as UWB SRRs the system would have to employ several different sensor modules or restrict the functionality e.g. to distance measurements only.

The UWB SRR systems operating in the 24,15 GHz ± 2,5 GHz or 24 to 29 GHz range provide a higher spatial resolution given by the higher bandwidth. Also the range of the forward distance measurement to objects or cars is from near zero to about 30 meters. Several modules installed e.g. in front and backward bumpers provide a surround looking performance (see figure A.1).

The 77 GHz ACC radar is designed for long range forward looking distance measurement with narrow beam forming and combined with limited scanning performance. The systems are designed for automotive cruise control primarily on highways to maintain distance to proceeding vehicles within a pre-settable speed limit. The operating range is up to approximately 150 m but the minimum operational distance is 30 m.

The 79 GHz systems provide enhances performance for all three functions as measuring distance resolution, the detection and position determination of smaller object sizes and the relative velocity to other cars. The smaller size provides more designer freedom which is a continued requirement from the car industry.

The fact that the radar frequencies for ACC 77 GHz and 79 GHz SRR are adjacently allocated bands allows the combination of both sensor technologies in a single module. This lowers the system cost as compared to individual sensor modules provided for ACC and SRR individually.

The combined installation 24 GHz SRRs with 76 GHz ACC provides the optimum of safety functionality and is already practiced in cars on the road [i.13].

B.1.2 Design considerations for 24 GHz to 29 GHz SRR systems

The 24,15 GHz ± 2,5 GHz UWB SRR systems referenced in clause B.1.1 can be adapted to the proposed frequency range without major redesign and can be placed onto the marketed as product variants. The transition time from present 24,15 GHz ± 2,5 GHz systems to the proposed frequency range is rather short.

The UWB SRRs can reduce the residual carrier of pulsed position modulation systems to the UWB limits by a combination of two methods:

1) Improved carrier isolation techniques in the hardware and tight control of the hardware tolerances.

2) Spread spectrum techniques to reduce the residual carrier generated in step #1.

It is up to the supplier of the sensor equipment to determine the proper balance for the ratio of improvement from both methods.

The SRRs based on carrier-based UWB technology (e.g. PN or FMCW) can also reduce emissions in certain parts of the spectrum used by SRR (e.g. by code modulation in case of PN or by not using the respective frequency steps in case of FMCW).

B.2 Technical justifications for spectrum

B.2.1 Power issues

The vehicular SRRs in the 24 GHz ranges operate at very low power levels of -41,3 dBm/MHz while in UWB mode. Some car manufacturers and equipment suppliers have designed automotive radar systems that operate in the SRD band from 24,05 GHz to 24,25 GHz with the higher emission power of +20 dBm over entire bandwidth. A mixed operation mode (either UWB or SRD band) is planned by some of the automotive suppliers.

A consideration of even lower limits as -41,3 dBm/MHz for UWB SRRs will cut the operational parameters and not meet the required functionality and is internationally not compatible.

B.2.2 Frequency issues

The main justification for the need of a UWB operation mode is resolution and object separation capability. For some safety-critical application a precise localization and separation is needed, which is mainly in the near vicinity around the car up to maximum 30 m (=best fit for UWB operation). Other mid-range applications need less resolution but higher distance and therefore higher power (=best fit for SRD band operation).

Due to mounting space restrictions higher frequencies as the 79 GHz range are always in the focus, but economy of scales prevents a too fast shift up in frequencies. Therefore the 24 GHz to 29 GHz SRR allocation is required. A minimum total bandwidth of 4 GHz as used by the 79 GHz SRR technology and within the 24 GHz to 29 GHz frequency range is required to provide the needed object resolution.

B.2.3 New radio parameter proposal

The constraints that are actually imposed to the operation of 24 GHz UWB SRR in Europe make an even moderate market proliferation impossible. Due to the severe limits imposed by the passive services in the 23,6 GHz to 24 GHz band a frequency shift avoiding the protected frequency range is the only reasonable way forward. A new European frequency mask (see figure B.2.3) is therefore proposed which avoids any intentional emission in the restricted band. As noted economical constraints prevent an immediate shift up to 79 GHz but do require this intermediate step.

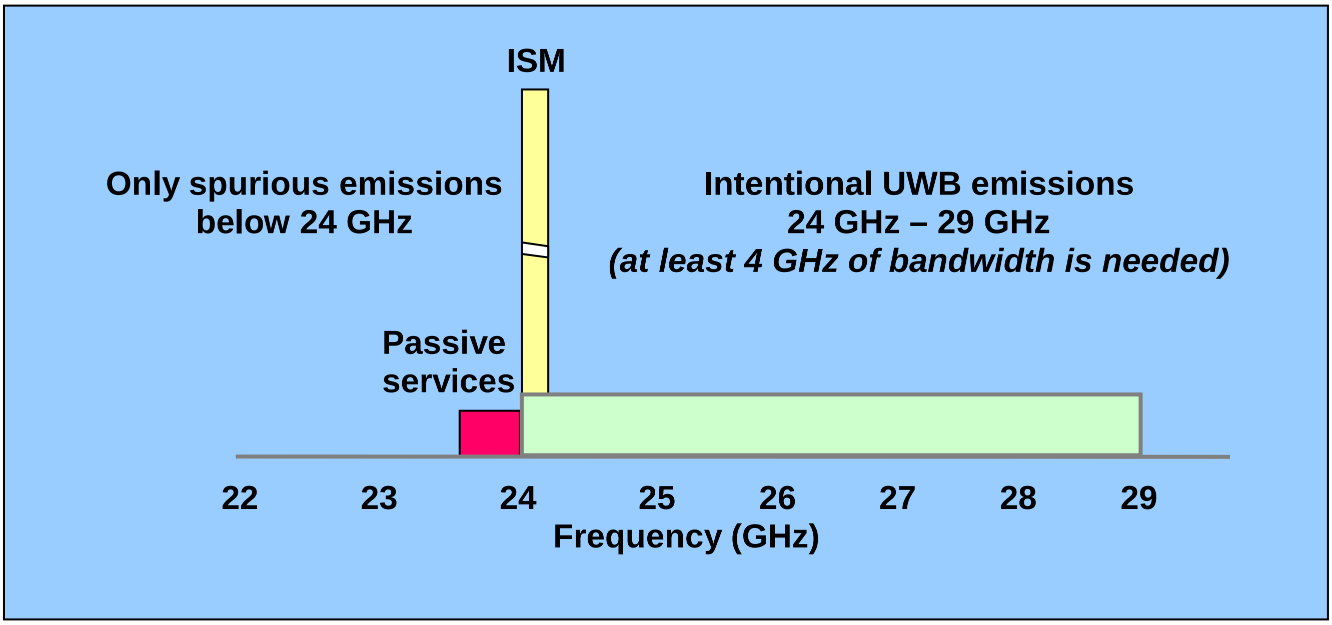

Figure B.2.3: Frequency band proposal for the 24 GHz to 29 GHz band

B.2.4 Summary of the new UWB SRR proposal versus 24 GHz UWB SRRs

Table B.2.4 compares the proposed parameters of the present 24 GHz solution as investigated in section 2 of the ECC Report 23 [i.10] in order to facilitate compatibility.

Table B.2.4: Parameter comparison of present proposal to 24 GHz SRR

Parameter	Proposed	Present	Comment
Frequency range	24 GHz to 29 GHz	Narrowband: 24,05 GHz to 24,25 GHz Wideband: 22,65 GHz to 25,65 GHz	
Power levels narrowband (24,05 GHz to 24,25 GHz) Peak Power (e.i.r.p.)	+20 dBm	+20 dBm	
Power levels wideband (24,25 GHz to 29 GHz) Average PSD (e.i.r.p.) Peak Power (e.i.r.p.)	-41,3 dBm/MHz 0 dBm/50 MHz	-41,3 dBm/MHz 0 dBm/50MHz	
Modulation	PNPPM, PNFH, PNPSK, Pulsed FM,	PNPPM, PNFH, PNPSK,	
Out of Band Emissions (10 GHz to 40 GHz) Radiated	-61,3 dBm/MHz	-61,3 dBm/MHz	
Emissions into protected bands according to Footnote 5.340	None	Emissions at -41,3 dBm/MHz level	
Other Factors	Global harmonization feasible	No global harmonization possible	
	Higher production volumes, penetration and impact on eSafety	Very limited penetration and impact on e-Safety	

Studies in ITU-R Task Group 1/8 have come to different conclusions as in ECC Report 23 [i.10] as a result of different assumptions. The studies derive different numerical conclusions based on two different FS deployment cases with the assumptions described below.

For a better understanding of compatibility in realistic traffic scenarios it is helpful to investigate different radio interference scenarios with suitable simulation tools, e.g. SEAMCAT

B.3 Information on current version of relevant ETSI standard

The current version of the Harmonized Standard EN 302 288 [i.9] (V1.4.1) is not applicable because of the different frequency range and the number of restrictions imposed.

Coexistence and compatibility issues with incumbent, active frequency services are by physics similar for all possible frequency ranges where primary services are allocated. In contrast to passive bands that are unique and narrow regarding the frequency ranges, the coexistence question with active services leads always to the same results, irrespective of the prevailing frequency range.

Annex C: Expected compatibility issues

C.1 Existing allocations

The present allocations concerning the proposed frequency range are provided in table C.1.

Table C.1: Allocations in the range of 24,25 GHz to 29 GHz

Frequency band	Allocations	Applications
24,0 GHz to 24,05 GHz	AMATEUR AMATEUR-SATELLITE	Amateur-satellite Amateur (24,0 GHz to 24,25 GHz) ISM (24,0 GHz to 24,25 GHz) Non-specific SRDs (24,0 GHz to 24,25 GHz) SAP/SAB and ENG/OB (24,0 GHz to 24,25 GHz)
24,0 GHz to 24,25 GHz	RADIOLOCATION Amateur Earth Exploration-Satellite (active) Fixed Mobile	Amateur (24,0 GHz to 24,25 GHz) ISM (24,0 GHz to 24,25 GHz) Non-specific SRDs (24,0 GHz to 24,25 GHz) SAP/SAB and ENG/OB (24,0 GHz to 24,5 GHz) Defence systems Detection of movement Weather satellites Detection of movement (24,05 GHz to 27,0 GHz)
24,25 GHz to 24,45 GHz	FIXED MOBILE	SAP/SAB and ENG/OB (24,0 GHz to 24,5 GHz) Detection of movement (24,05 GHz to 27,0 GHz) SAP/SAB P to P audio links (24,25 GHz to 24,5 GHz) SAP/SAB P to P video links (24,25 GHz to 24,5 GHz)
24,45 GHz to 24,5 GHz	FIXED MOBILE	SAP/SAB and ENG/OB (24,0 GHz to 24,5 GHz) Detection of movement (24,05 GHz to 27,0 GHz) SAP/SAB P to P audio links (24,25 GHz to 24,5 GHz) SAP/SAB P to P video links (24,25 GHz to 24,5 GHz)
24,5 GHz to 24,65 GHz	FIXED	Detection of movement (24,05 GHz to 27,0 GHz) Fixed links (24,5 GHz to 26,5 GHz) Point-to-Multipoint (24,5 GHz to 26,5 GHz)
24,65 GHz to 24,75 GHz	FIXED	Detection of movement (24,05 GHz to 27,0 GHz) Fixed links (24,5 GHz to 26,5 GHz) Point-to-Multipoint (24,5 GHz to 26,5 GHz)
24,75 GHz to 25,25 GHz	FIXED	Detection of movement (24,05 GHz to 27,0 GHz) Fixed links (24,5 GHz to 26,5 GHz) Point-to-Multipoint (24,5 GHz to 26,5 GHz)
25,25 GHz to 25,5 GHz	FIXED INTER-SATELLITE MOBILE	Detection of movement (24,05 GHz to 27,0 GHz) Fixed links (24,5 GHz to 26,5 GHz) Point-to-Multipoint (24,5 GHz to 26,5 GHz)
25,5 GHz to 26,5 GHz	FIXED INTER-SATELLITE MOBILE Earth Exploration-Satellite (space-to-Earth)	Detection of movement (24,05 GHz to 27,0 GHz) Fixed links (24,5 GHz to 26,5 GHz) Point-to-Multipoint (24,5 GHz to 26,5 GHz)
26,5 GHz to 27,0 GHz	FIXED INTER-SATELLITE MOBILE Earth Exploration-Satellite (space-to-Earth)	Detection of movement (24,05 GHz to 27,0 GHz) Defence systems (26,5 GHz to 27,5 GHz)
27,0 GHz to 27,5 GHz	FIXED INTER-SATELLITE MOBILE Earth Exploration-Satellite (space-to-Earth)	Defence systems (26,5 GHz to 27,5 GHz)

Frequency band	Allocations	Applications
27,5 GHz to 28,5 GHz	FIXED FIXED-SATELLITE (space-to-Earth) (Earth-to-space)	FSS Earth stations (27,5 GHz to 28,0525 GHz) SIT/SUT (27,5 GHz to 28,0525 GHz) Feeder links (27,5 GHz to 29,5 GHz) Fixed links (27,8285 GHz to 28,4445 GHz) Point-to-Multipoint (27,8285 GHz to 28,4445 GHz) FSS Earth stations (28,4445 GHz to 29,0605 GHz) SIT/SUT (28,4445 GHz to 29,0605 GHz)
28,5 GHz to 29,1 GHz	FIXED FIXED-SATELLITE (Earth-to-space) Earth Exploration-Satellite (Earth-to-space)	Feeder links (27,5 GHz to 29,5 GHz) FSS Earth stations (28,4445 GHz to 29,0605 GHz) SIT/SUT (28,4445 GHz to 29,0605 GHz)

C.2 Coexistence and sharing issues

New coexistence studies are needed, most notably for co-existence with Defence Systems and Fixed Services, as far as not covered by existing studies performed for UWB SRRs in the ECC.

ITU-R Recommendation SM.1757 [i.23] needs to be considered.

History

Document history		
V1.1.1	April 2009	Publication