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System Reference document (SRdoc);
Short Range Devices (SRD):
Technical Characteristics for Radio Equipment used for power transfer and communication with associated peripheral devices using the 917,5 MHz RFID interrogator channel

Reference

DTR/ERM-597

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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.

Modal verbs terminology

In the present document "**should**", "**should not**", "**may**", "**need not**", "**will**", "**will not**", "**can**" and "**cannot**" are to be interpreted as described in clause 3.2 of the ETSI Drafting Rules (Verbal forms for the expression of provisions).

"**must**" and "**must not**" are **NOT** allowed in ETSI deliverables except when used in direct citation.

Executive summary

This System Reference document seeks to allow a new use case for the 917,5 MHz channel, presently designated for RFID as per CEPT ERC Recommendation 70-03 annex 11 [i.2] and also covered in ECC Report 200 [i.3].

Presently, four fixed channels in the frequency band 915 MHz to 921 MHz are identified for RFID. This request seeks to use one of those channels (917,5 MHz) for a new purpose.

This new application uses a radiated radio frequency signal from a transmitter, for identifying the presence of a receiver to be charged or powered; and then uses a similar signal at the same frequency for wireless power transmission. Therefore, it is a form of Radio Frequency IDentification (RFID) with Wireless Power Transmission (WPT).

The equipment requires only a single RF channel to operate and one of the centre channels has been identified to minimize interference with adjacent radio services.

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

Introduction

The present document has been prepared to propose the use of Radio Equipment for power transmission and communication with associated receiver devices, operating at 917,5 MHz.

This Radio Equipment differs from existing RFID systems by the type of communication between the transmitter and receiver, and therefore does not fit within ETSI EN 302 208 [i.1] (latest edition).

The Radio Equipment within the scope of the present document uses low data rate in-band communication at 917,5 MHz.

The occupied bandwidth of the signal at 917,5 MHz is maintained within the existing spectrum mask for RFID. The communication contained in the 917,5 MHz transmission is expected to be used by the transmitter to identify the presence of a receiver device; or by the receiver to identify the presence of a transmitter device.

The application is intended for indoor use to meet the radio characteristics already prescribed by CEPT ERC Recommendation 70-03 [i.2], annex 11, as used by the RFID systems within the scope of ETSI EN 302 208 [i.1] i.e. a maximum ERP of 4 Watts and a maximum occupied bandwidth of 400 kHz. These parameters are as specified in ECC Report 200 [i.3].

1 Scope

The present document describes technical characteristics of Radio Equipment used for power transfer and communication with associated peripheral devices using the 917,5 MHz currently identified as an RFID interrogator channel.

The present document contains the necessary information to support the possible co-existence and compatibility studies if required, and to be conducted by the CEPT/ECC, including:

- Market information
- Technical information
- Regulatory issues

2 References

2.1 Normative references

Normative references are not applicable in the present document.

2.2 Informative references

References are either specific (identified by date of publication and/or edition number or version number) or non-specific. For specific references, only the cited version applies. For non-specific references, the latest version of the referenced document (including any amendments) applies.

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

The following referenced documents are not necessary for the application of the present document, but they assist the user with regard to a particular subject area.

[i.1] ETSI EN 302 208 (V3.3.1): "Radio Frequency Identification Equipment operating in the band 865 MHz to 868 MHz with power levels up to 2 W and in the band 915 MHz to 921 MHz with power levels up to 4 W; Harmonised Standard for access to radio spectrum".

[i.2] CEPT ERC Recommendation 70-03 (23 October 2020): "Relating to the use of Short Range Devices (SRD)".

[i.3] Addendum to ECC Report 200 (May 2020): "Additional co-existence studies between SRDs/RFIDs and E-GSM-R in the 900 MHz frequency band".

NOTE: Available at https://docdb.cept.org/download/26ce1d81-2a81/Addendum%20of%20ECC%20Report%20200.pdf.

[i.4] Commission Implementing Decision (EU) 2018/1538 of 11 October 2018 on the harmonisation of radio spectrum for use by short-range devices within the 874-876 and 915-921 MHz frequency bands.

[i.5] ECC Report 200: "Co-existence studies for proposed SRD and RFID applications in the frequency band 870-876 MHz and 915-921 MHz".

[i.6] ERC report 25: "The European Table Of Frequency Allocations And Applications In The Frequency Range 8.3 kHz to 3000 GHz (ECA TABLE)".

[i.7] ETSI EG 203 336 (V1.2.1): "Guide for the selection of technical parameters for the production of Harmonised Standards covering article 3.1(b) and article 3.2 of Directive 2014/53/EU".

[i.8] ETSI EN 303 659: "Short Range Devices (SRD) in Data Networks; Radio equipment to be used in the frequency ranges 865-868 MHz and 915-919,4 MHz; Harmonised Standard for access to radio spectrum".

[i.9] ECC Report 313: "Technical study for the coexistence between RMR in the 900 MHz range and other applications in adjacent bands".

[i.10] CEPT/ERC/Recommendation 74-01E: "Spurious Emissions".

3 Definition of terms, symbols and abbreviations

3.1 Terms

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

client device: receiving end of the communication link e.g. mobile part/energy receiving part of the energy from the transmitter, comprising the combination of an antenna, communication device and/or energy storage in one housing

contact charger: device where RF energy is generated and transferred by close coupling to the secondary (client device) device by means of radiation to power a device, or to charge or re-charge the battery or energy source for a device

load: See term for *client device*.

receiver: device that receives an RF signal or RF power transmission from a transmitter device

short distance charger: device where RF energy is generated and transferred by means of radio waves to power a device, or to charge or re-charge the battery or energy source for a device where the operating distance is not expected to be greater than 40 cm

transmitter: device that sends an RF signal and/or RF power to a receiver device

NOTE 1: The transmitter is made up of a combination of an individual antenna or antenna array, communication device and/or connection to an AC power supply. The configuration is application specific.

NOTE 2: Other expressions: charger or charging pad.

Wireless Power Transmission (WPT): transmission of electrical energy from a power source (Transmitter) to an electrical load (client device) via electric and/or magnetic fields or waves between a primary and a secondary device

3.2 Symbols

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

E	electric field strength
f	frequency
P	Power

3.3 Abbreviations

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

BLE	Bluetooth® Low Energy
CEPT	European Conference of Postal and Telecommunications Administrations
EAS	Electronic Article Surveillance
ECC	Electronic Communications Committee
ERC	European Radiocommunications Committee
e.r.p/ERP	Effective Radiated Power
ISM	Industrial Scientific Medical
RF	Radio Frequency

RFID	Radio Frequency Identification
SRD	Short Range Device
UHF	Ultra High Frequency
WPT	Wireless Power Transmission

4 Comments on the System Reference Document

4.1 Statements by ETSI members

ETSI members making comments should endeavour to reach consensus amongst themselves, to minimize the number of comments. If consensus cannot be reached on a clause, then it is divided into two sections: one for the proponents and one for comments on the text of the proponents. Such statements should be clearly attributable to the ETSI member(s) making these statements.

ITRON:

"Some members expressed concern at the principle of using SRD communications bands for high power, far-field wireless power transfer, given this band is not an ISM (Industrial Scientific and Medical) band, and in several European countries is used for military and/or railway communications".

"Belgium, Finland, UK, Switzerland all only allow two RFID channels, and therefore this system would take out 50 % over the capacity of the band, rendering RFID commercially worthless, and probably undermining the market in other countries where three channels are available".

Ministry of Economic Affairs (Netherlands):

"The Netherlands is of the opinion that the frequency band 915-921 MHz and any other band outside the regular ISM bands should not be used for beam WPT."

"All frequency ranges with telecommunications applications should be avoided, specially the 915-921 MHz and 870-876 MHz bands which are in use by military applications in The Netherlands."

"Also the deployment of these relatively high power devices cannot be compared with RFID and NAP's in these bands and is likely incompatible."

"The ISM frequency bands 433.050-434.790 MHz, 2,400-2,483,5 GHz and 5,725-5,875 GHz as indicated in the radio regulations may be used for that."

"We are also urging to use a low bandwidth in these bands typical 100 Hz or lower to avoid unnecessary interference to Short range Device applications."

"Also using the high power charger signal to send telemetry about the charging process cannot be considered spectrum efficient in our opinion."

Nedap N.V.:

"ETSI EN 302 208 defines the high band channels 3, 6, 9 and 12 in the range 916.1 to 920.9MHz.
Not all EU countries allow 4 channels. Many countries allow only 3 channels, or worst case only two channels (Belgium ?)
This will result that for EAS systems when surrounded by a WPT system only one channel will be left, assuming that the WPT channel cannot be used for RFID. For a correct operating EAS system at least 2 channels, but better 3 channels shall be available."

"If WPT is employed on channel 6 in a store with the carrier 100% of the time on, almost certainly this channel cannot be used anymore for EAS applications due to interference. This will reduce the overall performance of this EAS application."

"Section 8.8 Conclusions states natural geographically separation. Especially in smaller stores this will probably not be the case. In a store employing UHF RFID in the 916.1 to 920.9MHz band and WPT at channel 6 will very likely interfere with the EAS system.
When there is a WPT channel active, the tags that receiving this will indeed be able to start up earlier, but due to the high amount of power, these tags will not be able to receive any information from their base system."

AIM:

"Regarding the RFID testing the most relevant test is not performed, charging co-located at the same channel as the RFID reader, also not tested if there is any interference to the other two RFID lowers channels from the charging channel. Is there any interference to a RFID reader operating at 865-868MHz and a charger operating at the 917 MHz range."

"There is no information on how the reader reports successful vs. failed read attempts, it is possible that the reader is doing some smoothening or averaging of the results, hence even 10/10 doesn't mean that all the reads at the radio level were successful."

"This is such a new use case, it will need additional studies and this should be acknowledged in the SRdoc, not just claim it has the same interference potential as RFID."

"This is a nomadic application, only when in use it is fixed. It is not like (fixed) RFID. Needs studies."

"The EC Decision (EU) 2018/1538 is referring to radio devices as there are Non-specific short range devices, Wide data transmission devices, RFID devices and not to Wireless Power Transfer.

NOTE: At this moment not clear what the density will be."

FEIG ELECTRONIC GmbH:

"No coexistence measurements were made with RFID readers operating on the EU upper band. There are only simple tests with a reader that operates on the FCC band with hopping and a reader that operates in the EU lower band. The present coexistence measurement is therefore not meaningful.
The coexistence measurement should be repeated with an RFID reader on the upper band. The RFID reader should be operated on all channels of the upper band. Additionally, transponders from different manufacturers (e.g. NXP, Impinj, Alien, ...) should be used for the test."

Ericsson:

"Ericsson´s concerns about WPT in this frequency range: Expected density of these devices per household is high. Active charging time during a day must be considered. Suggested power level 4 W is >10 dB higher than for a regular UE in cellular communication. Because proposed frequency separation is much smaller, any UE duplex filter will have less suppression of a blocker. Proposed spurious emission limit -36dBm/100 kHz is >20dB above the allowed UE emissions in its own receiving band."

Federal Ministry of Economic Affairs and Energy/BMWi (Germany):

"BMWi is of the view that the frequency band 915-921 MHz should not be used for beam WPT applications."

"The frequency band 915-921 MHz is allocated to the mobile service (except aeronautical mobile service) on ITU level (Region 1) and on CEPT level. Based on this allocation in a number of CEPT countries including Germany these bands or parts thereof cannot be made available for SRD/RFID or WPT because of military radio applications and/or a designation for railway communication systems (extended GSM-R bands). Sharing of SRDs/RFID with those incumbent applications is in general not feasible (see ECC Report 200)."

Ministère de l'Economie et des Finances (France)

"The Ministère de l'Economie et des Finances (France) is of the view that the frequency band 915-921 MHz should not be used for beam WPT applications."

"In fact, the band 915-919.4 MHz is EU harmonised for various SRD applications. Therefore, the use of beam WPT applications in 915-919.4 MHz would compete with existing applications for spectrum access and have to coexist with adjacent ones as RMR. In specific context, current regulatory framework includes particular provisions (usage may be limited to professional users and subject to individual authorisation as to administer geographical sharing). Similar provisions cannot be for mass market WPT devices and ISM band should be used for such applications."

ETSI TC RT:

- *"The deployment of these high-power charging devices cannot be compared with regular/normal RFID applications with much lower duty cycles in these bands and is likely to be incompatible with adjacent RMR applications."*

- *"The use case for the proposed RF power transmission may differ significantly from that considered in previous studies for the regular RFID devices. For example, the use in trains for charging traveler's wireless device (mobile phones and various other consumer devices) and the growing availability of 230V ac power sockets in trains for traveler usage may well increase the deployment density."*

"This combined with the 100% duty cycle needs further co-existence analyses."

- *"Existing sharing and compatibility studies in ECC Report 313 are highlighting for the GSM-R carrier at 919.6 MHz that in some worst-case scenarios, the GSM-R cab-radio receiving at 919,6 MHz may face interference already from 25 mW SRD resulting in receiver blocking. When taking into account the RF power transmission at 917,5 MHz with up to 4 W (e.r.p.) and 100% duty cycle, significantly more interference issues to existing GSM-R radio applications are to be expected."*

- *"ECC Report 313 considered for the future FRMCS cab-radios that a spurious emission limit of -36 dBm/100 kHz from fixed RFID interrogators in a professional usage with low duty cycle is necessary to ensure co-existence between RFID interrogators and RMR cab-radios. Due to the proposed high RF power transmission at 917,5 MHz of up to 4 W (e.r.p.) and 100% duty cycle, significant blocking effects for the FRMCS cab-radios are expected."*

- *"ERC Recommendation (70-03) noted that the use of SRD is usually covered by general / non-exclusive authorizations on a non-protected and non-interference basis."*

"From today´s perspective, it is not clear to the rail sector how the proposed WPT with 4 W RF power transmission can result in a non-interference basis for existing and new railway radio equipment. Given the likelihood of significant blocking effects on RMR devices, rail sector requests that further co-existence analyses be performed on the proposed RF power transmission prior to progressing the TR 104 774 to CEPT."

NOTE: ETSI TR 104 774 does not exist. Statement made by ETSI TC RT above is a direct copy of their e-mail. This might be a typing error, they may be referring to the present document instead.

5 Presentation of the system or technology

5.1 The Technology

This equipment is intended to be interoperable, in that the transmitter will work with a range of receiver or load devices, supplied by multiple equipment manufacturers. The transmitter equipment uses an RF signal to interrogate the receiver or load and provide the appropriate RF power transmission at 917,5 MHz.

The use case is aimed at consumer and similar applications, and intended for indoor use. The most common application is expected to be the wireless charging of batteries in the receiver device, such that the receiver may be considered as a load for charging. The radio equipment may transfer power to one receiver or multiple receivers within the radiated field. At the time of writing the present document, it is anticipated that a maximum of 2 or 3 devices would be charged at any one time.

At the time of writing the present document, two types of systems are anticipated. Contact systems whereby the receiver is placed directly in contact or very close proximity (e.g. max 1 cm distance) to the transmitter and; Short distance charger systems, whereby the receiver is placed in an area near to the transmitter. For short distance charger the working distance is expected to be approximately 40 cm.

The radio equipment output power is limited to 4 Watts ERP per charging area or transmission; regardless of how many receiver load devices are placed in the charging area.