

**Electromagnetic compatibility
and Radio spectrum Matters (ERM);
System Reference Document;
Short Range Devices (SRD);
Technical characteristics for Location tracking Applications
for Emergency Services (LAES) in disaster situations
operating within the frequency range from 3,4 GHz to 4,8 GHz**

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SRD, SRDoc**ETSI**650 Route des Lucioles
F-06921 Sophia Antipolis Cedex - FRANCE

Tel.: +33 4 92 94 42 00 Fax: +33 4 93 65 47 16

Siret N° 348 623 562 00017 - NAF 742 C
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Foreword

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

Introduction

Ultra Wide Band (UWB) technology enables a new generation of Location Tracking and Sensor devices and opens new markets with very different applications. UWB radio location and sensor devices with an operating bandwidth of several hundreds of MHz up to more than one GHz allow tens of centimetre-level localization and positioning even in the presence of severe multipath effects caused by walls, furniture or any other harsh radio propagation environments.

The applications described in the present document are intended to become an essential part of the Public safety operations.

The purpose of producing the present document is to lay a foundation for industry to quickly bring innovative and useful products to the market.

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

Status of pre-approval draft

The present document was developed by ERM_TG31C.

Target version	Pre-approval date version (see note)			Date	Description
	a	S	m		
V1.1.1					
V1.2.1		0.1.0		February 21 st 2008	First draft at TG31C mtg 15
		0.2.0		17 April 2008	Revised for TG31C mtg 16
		0.3.0		18 April 2008	Revised at TG31C mtg 16
		0.4.0		30 May 2008	Sent to TCF for review
		0.5.0		02 June 2008	Sent to TG31C for review
V2.1.1		0.4.7		27 June 2008	ETSI internal enquiry version - with rev marks
V2.1.1		0.4.8		27 June 2008	ETSI internal enquiry version - clean copy
V2.1.1		0.4.9		21 August 2008	Incorporation of comments from ETSI internal enquiry
V2.1.1		0.4.10		3 September 2008	Minor editorials
V2.1.1		0.4.11		3 September 2008	Clean version of v1.1.1_0.4.10.
V2.1.1		0.4.12		4 September 2008	Editorial on sentence above table 3; Editorial also to harmonize use of internal ETSI procedure to be an "enquiry"
V2.1.1		0.4.13		4 September 2008	Clean version of v2.1.1_0.4.12 plus deletion of extra "for" in sentence above table 3

NOTE: See clause A.2 of EG 201 788 [i.14].

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1 Scope

The present document defines the requirements for radio frequency usage for short range Ultra Wide Band (UWB) location tracking devices to be used only by emergency services (e.g. fire workers, police, civil protection authorities) in critical situations or in surveillance operations and operating within the frequency range from 3,4 GHz to 4,8 GHz. A licensing approach is suggested for these applications.

Additional information is given in the following annexes:

- 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] CEPT/ECC Report 64 (February 2005): "The protection requirements of radiocommunications systems below 10,6 GHz from generic UWB applications"; Helsinki.

NOTE: Available at <http://www.ero.dk/doc98/Official/pdf/ECCREP064.pdf>.

- [i.2] CEPT/ERC Report 25: "The European table of frequency allocations and utilisations in the frequency range 9 kHz to 3 000 GHz". (Lisboa 02, Dublin 03, Kusadasi 04, Copenhagen 04, Nice 07).

NOTE: Available at <http://www.erodocdb.dk/docs/doc98/official/pdf/ErcRep025.pdf>.

- [i.3] Document TG3#7-19R0 (1-3 March 2005): "Effects of PSD limits on UWB positioning systems"; submitted to ECC TG3 meeting, Brest.
- [i.4] FCC 03-33: "Revision of Part 15 of the Commission's Rules Regarding UWB Transmission Systems".
- [i.5] ECC/DEC/(06)04 of 24 March 2006 on the harmonized conditions for devices using Ultra-Wideband (UWB) technology in bands below 10,6 GHz.
- [i.6] Revised Terms of reference for ECC TG3 (July 2006).
- [i.7] ECC/DEC(06)04 - update June 2007, /DEC/(06)04 amended 6 July 2007: "ECC Decision of 24 March 2006 amended 6 July 2007 at Constanta on the harmonized conditions for devices using Ultra-Wideband (UWB) technology in bands below 10,6 GHz".
- [i.8] Commission Decision 2007/131/EC, 23rd Feb 2007 allowing the use of the radio spectrum for equipment using ultra-wideband technology in a harmonized manner in the Community.
- [i.9] ECC/DEC/(06)12: "ECC Decision of 1 December 2006 on the harmonized conditions for devices using Ultra-Wideband (UWB) technology with Low Duty Cycle (LDC) in the frequency band 3,4 GHz to 4,8 GHz".
- [i.10] Draft ECC Recommendation (08)05 on the identification of frequency bands for the implementation of Broad Band Disaster Relief radio applications in the 5 GHz frequency range.
- [i.11] ECC Report 102 (January 2007): "Public protection and disaster relief spectrum requirements"; Helsinki.
- [i.12] Report ITU-R Recommendation M.2033: "Radiocommunication objectives and requirements for public protection and disaster relief".
- [i.13] ETSI TR 102 491: "Electromagnetic compatibility and Radio spectrum Matters (ERM); TETRA Enhanced Data Service (TEDS); System reference document".
- [i.14] ETSI EG 201 788 (V1.2.1): "Electromagnetic compatibility and Radio spectrum Matters (ERM) Guidance for drafting an ETSI System Reference Document".
- [i.15] ETSI EN 302 500 (all parts): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD) using Ultra WideBand (UWB) technology; Location Tracking equipment operating in the frequency range from 6 GHz to 8,5 GHz.
- [i.16] ETSI EN 302 435 (all parts): "Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Technical characteristics for SRD equipment using Ultra WideBand technology (UWB); Building Material Analysis and Classification equipment applications operating in the frequency band from 2,2 GHz to 8 GHz".
- [i.17] ECC Decision (07)01: " ECC Decision of 30 March 2007 on Building Material Analysis (BMA) devices using UWB technology ".
- [i.18] IEEE 802.15.4a: "IEEE Standard for Information technology - Telecommunications and information exchange between systems - Local and metropolitan area networks - Specific requirements; Part 15.4: Wireless Medium Access Control (MAC) and Physical Layer (PHY) Specifications for Low-Rate Wireless Personal Area Networks (WPANs); Amendment 1: Add Alternate PHYs".
- [i.19] ECC Report 64: "The protection requirements of radiocommunications systems below 10,6 GHz from generic UWB applications"; Helsinki, February 2005.

3 Definitions, symbols and abbreviations

3.1 Definitions

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

activity factor: reflects the effective transmission time ratio

maximum mean e.i.r.p. spectral density: highest signal strength measured in any direction at any frequency within the defined range

NOTE: The mean e.i.r.p. spectral density is measured with a 1 MHz resolution bandwidth, an RMS detector and an averaging time of 1 ms or less.

maximum peak e.i.r.p.: highest signal strength measured in any direction at any frequency within the defined range

NOTE: The peak e.i.r.p. is measured within a 50 MHz bandwidth centred on the frequency at which the highest mean radiated power occurs.

3.2 Symbols

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

Toff	the time interval between two consecutive bursts when the UWB emission is kept idle
Ton	the duration of a burst irrespective of the number of pulses contained
δR	Range resolution

3.3 Abbreviations

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

ABL	Anchor Based Localization
AFL	Anchor Free Localization
BBDR	Broad Band Disaster Relief
BU	Base Units
CEPT	European Conference of Post and Telecommunications administrations
CU	Control Unit
DAA	Detect and Avoid
DBPSK	Differential Binary Phase Shift Keying
DCLG	Department of Communities and Local Government
DR	Disaster Relief
DUs	Usually Dropped Units
e.i.r.p	equivalent isotropically radiated power
ECC	Electronic Communications Committee
FHUSB	Frequency-Hopping UWB
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
HSN	High Speed Network
INS	Inertial Navigation Systems
IR-UWB	Impulse Radio UWB
ITU-R	International Telecommunications Union - Radio sector
LAES	LocationTracking Applications for Emergency Services
LBT	Listen Before Talk
LDC	Low Duty Cycle
LOS	Line Of Sight
MU	Mobile Units
NLOS	Non Line Of Sight
PN	Pseudo Noise
PP2	Public Protection situations

PPDR	Public Protection and Disaster Relief
PRF	Pulse Repetition Frequency
PSD	Power Spectral Density
RF	Radio Frequency
SSDI	Social Security Disability Insurance
TDMA	Time Division Multiple Access
UWB	Ultra Wide Band

4 Comments on the System Reference Document

Comments received during the internal ETSI enquiry have been incorporated.

5 Executive summary

5.1 Background information

The present document describes new short-range location applications based on UWB technology which will be used in emergency situations. For these systems, no fixed installations are available to perform the localization as the place of events are not known in advance.

The system is composed of a set of nodes deployed as an ad-hoc network. It will provide accurate positioning information of objects or persons which are inside the building which is affected by the event. This means that the required signals necessarily demand a high bandwidth to provide the required accuracy which is better than one metre.

Two systems architecture can be used for such applications:

- Anchor Based Localization (ABL); and
- Anchor Free Localization (AFL).

For the systems based on Anchor Based Localization (ABL) at least three reference points which are inside or outside the building located in the sensitive area are needed. For Anchor Free Localization (AFL) systems, there is no need of reference points but a sufficient connectivity between the nodes inside the building is needed in order to obtain ranging information between all nodes. This implies that a high signal power is required in order to enable the penetration of obstacles (walls, etc.) and to enable a sufficient link distance between nodes inside the building. Based on these requirements, an increased power compared to current regulations of the UWB devices that will be used in such situation is needed and is discussed in the present document.

The users of the proposed system will be government agencies responsible for public safety primarily and so would be clearly defined organizations. It is suggested in the proposed regulation that users should be licensed, but not sites, since the equipment would only be operated when and where an emergency situation occurs. As described in [i.12], applications are used temporarily by emergency services in all aspects of disaster situations, including disaster prevention.

There is evidence that such a system will significantly enhance the security and sustainability of life of persons and therefore will provide a socio-economic benefit.

5.2 Market information

The intended market for this equipment is government agencies responsible for public safety: primarily fire and rescue services, but also including police and other services. (Note that the organization and names of these services vary between European states.) The members of these services work in dangerous environments and put their own lives at risk in order to protect the public, and being able to locate and track them makes their work safer. As a result of being safer, these workers can be more effective at saving the lives of the public.

This enhanced protection for public safety workers yields benefits over the full range of emergencies, so the market is potentially a large one.