ETSI TS 102 754 V1.2.1 (2008-11)

Technical Specification

Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD); Technical characteristics of Detect-And-Avoid (DAA) mitigation techniques for SRD equipment using Ultra Wideband (UWB) technology

Reference
RTS/ERM-TG31A-0120

Keywords
radar, radio, SRD, UWB

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
Association à but non lucratif enregistrée à la
Sous-Préfecture de Grasse (06) N° 7803/88

Important notice

Individual copies of the present document can be downloaded from:
http://www.etsi.org

The present document may be made available in more than one electronic version or in print. In any case of existing or perceived difference in contents between such versions, the reference version is the Portable Document Format (PDF). In case of dispute, the reference shall be the printing on ETSI printers of the PDF version kept on a specific network drive within ETSI Secretariat.

Users of the present document should be aware that the document may be subject to revision or change of status. Information on the current status of this and other ETSI documents is available at
http://portal.etsi.org/tb/status/status.asp

If you find errors in the present document, please send your comment to one of the following services:
http://portal.etsi.org/chaircor/ETSI_support.asp

Contents

Intellectual Property Rights

IPRs essential or potentially essential to the present document may have been declared to ETSI. The information pertaining to these essential IPRs, if any, is publicly available for **ETSI members and non-members**, and can be found in ETSI SR 000 314: *"Intellectual Property Rights (IPRs); Essential, or potentially Essential, IPRs notified to ETSI in respect of ETSI standards"*, which is available from the ETSI Secretariat. Latest updates are available on the ETSI Web server (http://webapp.etsi.org/IPR/home.asp).

Pursuant to the ETSI IPR Policy, no investigation, including IPR searches, has been carried out by ETSI. No guarantee can be given as to the existence of other IPRs not referenced in ETSI SR 000 314 (or the updates on the ETSI Web server) which are, or may be, or may become, essential to the present document.

Foreword

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

1 Scope

The present document provides the technical specifications of Detect And Avoid (DAA) mitigation techniques. These techniques are focused on the protection of active radio services.

The following DAA mechanisms have been identified to protect the:

- radio location services in the band 3,1 GHz to 3,4 GHz;
- broadband wireless access services in the band 3,4 GHz to 3,8 GHz;
- radio location services in the band 8,5 GHz to 9,0 GHz.

NOTE: The DAA mitigation techniques are to some extent generic and may also be used with modifications for the protection of other radio services in the future if the technical requirements are identified.

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.

For online referenced documents, information sufficient to identify and locate the source shall be provided. Preferably, the primary source of the referenced document should be cited, in order to ensure traceability. Furthermore, the reference should, as far as possible, remain valid for the expected life of the document. The reference shall include the method of access to the referenced document and the full network address, with the same punctuation and use of upper case and lower case letters.

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] ECC DEC(06)04: "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" (2007/131/EC).

[i.2] Draft amended ECC DEC(06)12: "ECC Decision of [1 December 2006] on supplementary regulatory provisions to ECC/DEC/(06)04 for UWB devices using mitigation techniques".

[i.3] ECC Report 120 (March 2008): "ECC Report on Technical requirements for UWB DAA (Detect and avoid) devices to ensure the protection of radiolocation in the bands 3.1-3.4 GHz and 8.5-9 GHz and BWA terminals in the band 3.4 - 4.2 GHz".

[i.4] ECC TG3#18-18R0: "Flexible DAA mechanism based on "isolation criteria" between victim service and UWB devices", ECC TG3 Meeting 18, Mainz, March 2007.

3 Definitions, symbols and abbreviations

3.1 Definitions

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

avoid implementation time: maximum time taken to adjust to a new TX parameter set following signal level measurement and identification, Parameter: $T_{avoid\ impl}$

avoidance level: maximum amplitude to which the UWB transmit power is set for the relevant protection zone

channel availability check interval: maximum time between two consecutive detect operations, Parameter: T_{avail}

detect and avoid time: time duration between a change of the external RF environmental conditions and adaptation of the corresponding UWB operational parameters

detection probability: probability that the DAA enabled UWB device reacts appropriately to a signal detection threshold crossing within the detect and avoid time

in operation channel availability check time: minimum time the UWB device spends searching for victim signals during normal operation, Parameter: $T_{in\ op\ avail}$

maximum avoidance power level: UWB transmit power assuring the equivalent protection of the victim service

minimum avoidance bandwidth: portion of the victim service bandwidth requiring protection

default avoidance bandwidth: portion of the victim service bandwidth to be protected if no enhanced service bandwidth identification mechanisms are implemented in the DAA enabled devices

minimum initial channel availability check time: minimum time the UWB device spends searching for victim signals after power on, Parameter: $T_{avail,\ Time}$

Non-Interference mode operation (NIM): operational mode that allows the use of the radio spectrum on a non-interference basis without active mitigation techniques

signal detection threshold: amplitude of the victim signal which defines the transition between adjacent protection zones, Parameter: D_{thresh}

signal detection threshold set: set of amplitudes of the victim signal which defines the transition between adjacent protection zones

victim signal: signal(s) of the service to be detected and protected by the DAA mitigation technique

3.2 Symbols

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

T	time
f	frequency
D	detection threshold
I	Isolation in dB
P	Power in dBm

3.3 Abbreviations

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

BPSK	Binary Phase Shift Keying
BWA	Broadband Wireless Access
DAA	Detect And Avoid
CEPT	European Conference of Postal and Telecommunications Administrations
CPC	Cognitive Pilot Channels
CW	Continuous Wave
dBm	deciBel relative to 1 mW
ECC	Electronic Communications Committee
e.i.r.p.	equivalent isotropically radiated power
ERM	Electromagnetic compatibility and Radio spectrum Matters
LDC	Low Duty Cycle
LFM	Linear Frequency Modulation
NIM	Non Interference Mode
RF	Radio Frequency
SRD	Short Range Device
TPC	Transmit Power Control
UWB	Ultra WideBand

4 Detect and avoid

4.1 Introduction

The present clause defines a Detect And Avoid (DAA) based interference mitigation architecture for UWB devices to protect active victim services. In the following clauses the basis for and the individual DAA parameters for protection of specific services will be given.

4.2 Zone model

The flexible DAA concept is based on the definition of different zones for which an appropriate UWB emission power level is authorized. Each zone corresponds to a minimum isolation between the potential victim system and the potential UWB interferer. Based on the minimum isolation an equivalent degree (see note below) of victim service protection is derived. This concept is embodied in the zone model.

As existing systems are subject to technological change and other systems may be deployed or developed in the future e.g. IMT-Advanced, it should be noted that different zone parameters and transmission levels may be required.

The zone model is based on the isolation between the victim device and the UWB device. By deriving the distances based on the isolation it is possible to segment the region of space around the victim receiver into discrete zones. In the first zone, zone 1, the UWB device shall operate in the non-interference mode (NIM) as defined in the non DAA regulatory framework [i.1] and [i.2] using the parameters give in table 1. In the last zone, zone *N,* the UWB device can operate without restrictions up to the maximum permitted power level of -41,3 dBm/MHz or as defined in a future DAA regulation for the corresponding operational frequency range. Between the zone 1 and zone *N* an arbitrary number of transition zones 2 to *N* -1 may be defined, provided equivalent protection can be assured. Based on the result of the detection process (clause 5) the UWB device has to determine the corresponding zone it occupies.

Table 1: Non-interference mode parameters in the band 3,1 GHz to 9,0 GHz

Operational Frequency	NIM Power levels (e.i.r.p.)	NIM Power levels (e.i.r.p.) with LDC implemented
3,1 GHz to 3,4 GHz	-70 dBm/MHz average. -36 dBm peak (see notes 2 and 3)	-41,3 dBm/MHz average. 0 dBm peak Standard LDC parameters as in [i.2]
3,4 GHz to 3,8 GHz	-80 dBm/MHz average. - 40 dBm peak (see notes 2 and 3)	-41,3 dBm/MHz average. 0 dBm peak Standard LDC parameters as in [i.2]
3,8 GHz to 4,2 GHz	-70 dBm/MHz average. -30 dBm peak (see notes 2 and 3)	-41,3 dBm/MHz average. 0 dBm peak Standard LDC parameters as in [i.2]
4,2 GHz to 4,8 GHz	-70 dBm/MHz average. -30 dBm peak (see notes 2 and 3)	-41,3 dBm/MHz average. 0 dBm peak Standard LDC parameters as in [i.2]
6,0 GHz to 8,5 GHz	-41,3 dBm/MHz average. 0 dBm peak (see note 2)	-41,3 dBm/MHz average. 0 dBm peak Standard LDC parameters as in [i.2]
8,5 GHz to 9,0 GHz	-65 dBm/MHz average. -25 dBm peak (see notes 2 and 3)	-41,3 dBm/MHz average. 0 dBm peak Standard LDC parameters as in [i.2]

NOTE 1: As defined in the scope of the present document, the DAA mitigation only affects the frequency bands 3,1 GHz to 3,4 GHz, 3,4 GHz to 3,8 GHz and 8,5 GHz to 9 GHz. NIM power levels for the other frequency bands are included in this table for informative purposes.

NOTE 2: Devices installed in road or rail vehicle not using LDC need to implement TPC as defined in [i.2].

NOTE 3: Devices fitted with DAA mitigation may operate to the maximum permissable limit of -41,3 dBm/MHz average and 0 dBm peak.

The zone model is illustrated in figure 1 for *N* = 4. This example has been taken from the CEPT ECC TG3 regulatory discussion [i.4]. The transition zones in this example are defined based on a 10 dB pathloss step size.

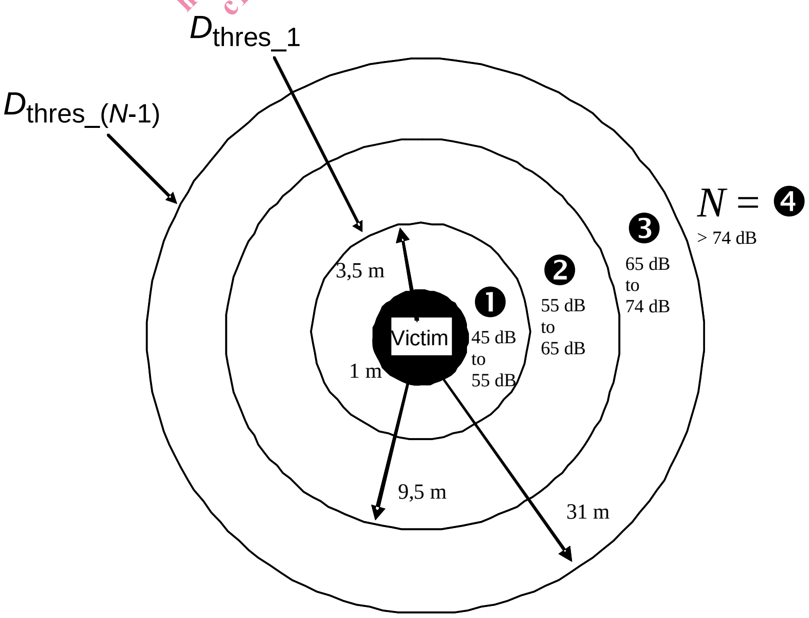

Figure 1: Zone model segmentation and corresponding path loss with LoS distance in meters for *N* = 4

4.3 Detect and Avoid operational flow

The defined zone model is incorporated into the overall detect and avoid operational flow. This flow is depicted in figure 2.

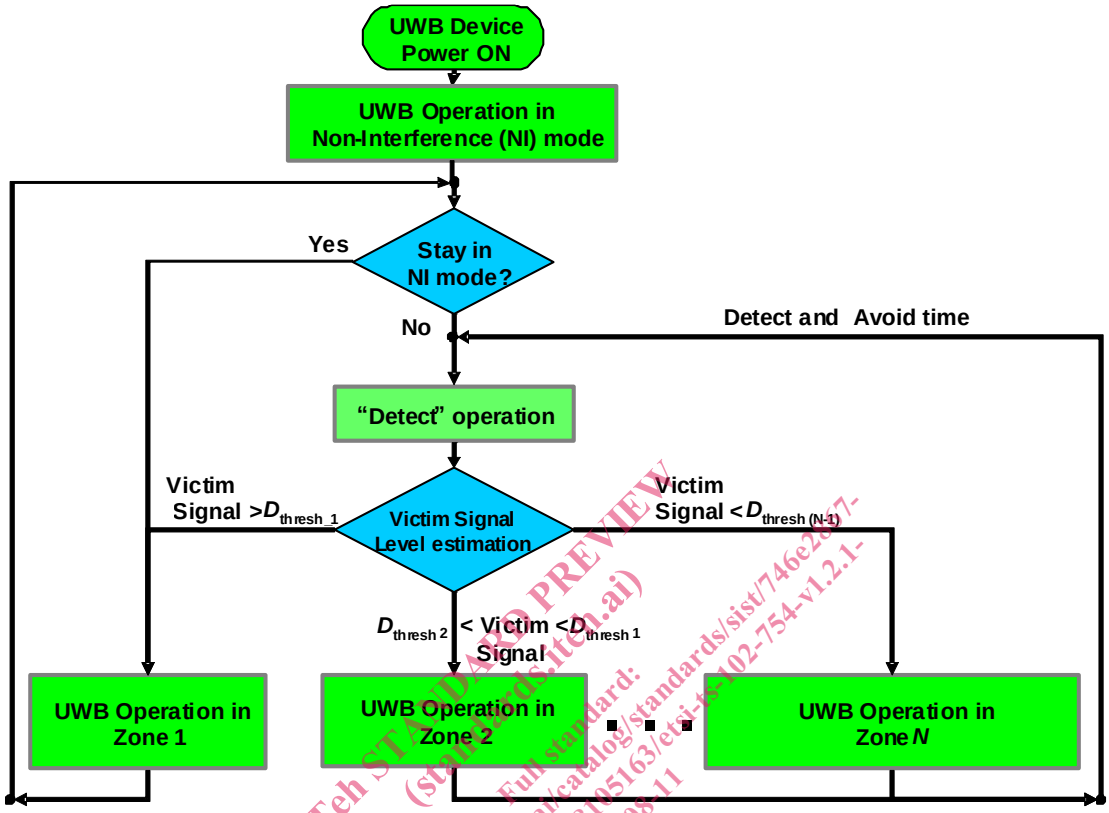

Figure 2: Detect and Avoid overview, including *N* zones

All UWB devices enter a non-interference mode at start-up. This non-interference mode can only be changed after a signal detect, estimation and decision process has been performed. Estimations are done against threshold levels D_{thres_n}, n = 1…*N*-1.

The non-interference mode operational zone can be subdivided into zones of equivalent protection where appropriate avoidance techniques are implemented. This gives rise to additional operational zones between the non-interference and free mode operational zones based on technical considerations. This multi zone concept is illustrated in figure 3 taking into account the reduction of the UWB transmit power after the application of the appropriate avoidance technique.