

ELECTRONIC COMMUNICATIONS COMMITTEE

ECC Decision
of 30 March 2007
on Building Material Analysis (BMA) devices
using UWB technology

(ECC/DEC/(07)01)



EXPLANATORY MEMORANDUM

1 INTRODUCTION

This ECC Decision has been developed in response to market demands for Building Material Analysis (BMA) devices using UWB technology devices. The ECC Decision should ensure that frequency bands are available on a harmonised basis to enable the introduction of UWB devices in a timely manner and ensuring economies of scale.

This ECC Decision has also been developed in the context of an EC mandate to CEPT to identify the conditions relating to the harmonised introduction in the European Union of radio applications based on ultra-wideband (UWB) technology.

It should be noted that this ECC Decision is designed to be part of a “regulatory package”, with various regulatory and legal provisions. A first generic ECC Decision for UWB applications within this frame was published by ECC in March 2006 (ECC/DEC/(06)04 which is intended to fit for most UWB applications within the frequency range 3.4 to 4.8 and 6 to 8.5 GHz).

The need for further ECC decision has to be clearly explained. The use of UWB technology in accurate imaging applications (e.g. building material analysis) is one example for an application which does not fit within the generic UWB decision because of physical reasons (e.g. reflections of clutter and penetration depth). The narrow pulses used by UWB imaging systems enable them to make sophisticated signal measurements, allowing material differentiation and analysis in 3-dimensional immediate vicinity on a millimeter-level positioning.

BMA devices will have a direct impact in a number of markets, such as workplace, security, and manufacturing. Market size estimates indicate the combined value of hardware, software and professional services for the UWB imaging industry. Development of this market will depend on the high accuracy and reliability provided by UWB systems.

Compared to generic UWB applications the market for BMA is not expected to be a mass market and the deployment will be significantly lower.

Users of BMA devices include skilled workers, experts, art historians, architects, planners, environmentalists, civil engineers as well as ordinary DIYs (“do-it-yourself”). The markets and applications for this technology are expected to primarily involve professional usage and low density deployments.

2 BACKGROUND

In response to demands brought to the attention of ECC by industry harmonised frequency bands are required for the introduction of BMA devices ensuring economies of scale and a harmonised introduction of these devices inside CEPT.

To fulfil this task the ECC initiated the related studies and in response to a mandate issued by the European Commission to develop technical implementing measures for the harmonised use of radio spectrum for UWB applications in the European Union, ECC established a Task Group to develop the ECC responses. In March 2006 a first ECC Decision was adopted for generic radio devices below 10.6 GHz that are exempt from individual licensing and operate on a non-interference, non-protected basis.

This first deliverable is applicable for most of UWB applications, but not for all. One group of UWB applications which does not fit within the generic UWB rules are imaging applications because of the need for a lower frequency boundary than allowed for generic UWB devices.

This ECC Decision applies to BMA devices in frequency range below 8 GHz that are exempt from individual licensing and operate on a non-interference, non-protected basis.

The use of the generic UWB decision is not applicable for these BMA devices because of the following reasons:

- Power limit of the generic decision from 1 to 3.4 GHz is too low for this application;
- A limit of about -50dBm/MHz e.i.r.p. is necessary because of wall attenuation and the sensitivity limitations of the receiver;
- The lower boundary of 2.2 GHz for operation at -50dBm/MHz e.i.r.p. is necessary because of reflections of clutter and object penetration;
- The upper boundary of 8GHz is necessary because the required bandwidth for determining the water content of walls and the needed resolution.

The main difficulties with the needed higher limits for these devices are in the frequency range below 3.4 GHz, where up to 35 dB are missing for compatibility with regard to ECC Report 64 but notably without considering additional mitigation factors.

BMA devices have user demographics, deployment density and activity factors which will help to protect existing users of the radio spectrum. Within the technical studies a maximum density of 6.7 units/km² for very dense urban areas with an average activity factor of 0.28% was considered. These devices are expected to be primarily used in professional and industrial environments rather than by consumers. The market requirement for long device battery lifetimes can ensure that devices transmit UWB signals with low activity factors or low average duty cycles. The low usage factor of BMA devices may permit less stringent protection requirements for all radio services than for generic UWB devices, e.g., increase of the separation distance from 36 cm to 3 m for mobile terminals.

There are a number of mitigating factors that will serve to limit interference to other services significantly, for example:

- Listen Before Talk (see Annex 2): This mechanism will assure that in the case of active radio services, interference will be avoided, for example:
 - S-Band Radar: a limit of -82 dBm/MHz e.i.r.p. is theoretically needed, -50 dBm/MHz e.i.r.p. with Listen Before Talk would require a threshold of -7dBm/MHz
 - UMTS at 2.6 GHz: assuming a separation distance of 3m a limit of -65 dBm/MHz e.i.r.p. is theoretically needed, -50 dBm/MHz with Listen Before Talk would require a threshold of -44dBm/3.84MHz as shown in an impact study.
- A reduced Total Radiated Power compared to the max. radiated power ensures that the emission from the device is not isotropic with the max limit (see Annex 1, bullet 1 c and note 2 to Table 1).
- To reduce the probability of interference (density, activity) it is proposed to allow the introduction of such devices with the following restrictions (see Annex 1, bullet 1 a):
 - emission only in contact or close proximity to a building structure
 - manual push button operation
 - movement detector for operation only when the device is in motion

3 REQUIREMENT FOR AN ECC DECISION

The allocation or designation of frequency bands under specified conditions in CEPT member countries is laid down by law, regulation or administrative action. ECC Decisions are required to deal with the carriage and use of equipment throughout Europe. The ECC also recognizes that for UWB devices to be introduced successfully throughout Europe, confidence must be given on the one hand to manufacturers to make the necessary investment in the new pan European Radiocommunications systems and services and on the other hand to users of existing services that their protection will be ensured.

The harmonisation on a European basis would support the *Directive 1999/5/EC of the European Parliament and of the Council of 9 March 1999 on radio equipment and telecommunications terminal equipment and the mutual recognition of their conformity.*

A commitment by CEPT member countries to implement an ECC Decision will provide a clear indication that the required frequency range will be made available on time and on a Europe-wide basis and that the means to ensure protection of existing services will be applied.

**ECC Decision
of 30 March 2007**

on Building Material Analysis (BMA) devices using UWB technology

(ECC/DEC/(07)01)

“The European Conference of Postal and Telecommunications Administrations,

considering

- a) the need for an harmonized regulatory framework for the operation of Building Material Analysis (BMA) devices using UWB technology within the CEPT;
- b) that the Decision ECC/DEC/(06)04 is published as basis regulation for the introduction of generic UWB applications within the CEPT;
- c) that in order to allow an introduction of BMA devices using UWB technology within the CEPT the use of the frequency range 2.2 to 8 GHz has been requested by the industry because:
 - there is a need for higher emission limits than those contained in Decision ECC/DEC/(06)04 in certain frequency ranges;
 - the large bandwidth is required for spatial resolution,
 - the low frequency bands are required for material penetration and clutter suppression,
 - the technology is available;
- d) that BMA devices using UWB technology operate on a non-interference, non-protected basis;
- e) that emissions of BMA devices extend over a large frequency range;
- f) that BMA devices may impact simultaneously several radiocommunication systems operating;
- g) that the density and activity of operation of BMA devices is expected to be low; within the technical studies a maximum density of 6.7 units/km² for very dense urban areas with an average activity factor of 0.28% was considered;
- h) that these BMA devices are not intended for communications purposes;
- i) that radiations into the air as a result of the operation of BMA systems are highly dependent on the operational conditions and are only meaningful if coupled with the material being investigated therefore a proximity sensor or a wall contact are necessary;
- j) that undesired emissions should be kept to minimum possible so as to minimize the impact on radio communication services;
- k) that BMA devices have to reduce the probability of interference to radio services by mitigation techniques and factors such as
 - manually controlled operation without a locking switch,
 - emissions only when in contact or close proximity to the investigated material,
 - movement detector,
 - handheld devices using internal battery power source,
 - low duty cycle,
 - Listen Before Talk,
 - Total Radiated Power (TRP) limitation;
- l) that for the limits given in Annex 1 and assuming line of sight propagation, the protection distance for ensuring the limits of ITU-R RA.769 for the most sensitive observation at 2.7GHz is 1.3km and at 4.9GHz 700m;
- m) that the operation of BMA devices in bands allocated to the Radio Astronomy Service may exceed the assumptions on power or deployment densities in this ECC Decision and may therefore increase the risk of interference given the uncontrolled nature of the deployment and activity of BMA devices;
- n) that administrations are encouraged to monitor the impact of BMA devices on radiocommunication services, especially on RAS;
- o) that based on the experience gained a review of this Decision should take place in 2010, and if necessary further measures could be introduced like automatic deactivation, light licensing or a more stringent limit;
- p) that the harmonised standard EN 302 435-2 (version V1.1.1) provides the conditions for LBT (Listen Before Talk);
- q) that in EU/EFTA countries the radio equipment that is under the scope of this Decision shall comply with the R&TTE Directive. Conformity with the essential requirements of the R&TTE Directive may be demonstrated by compliance with the applicable harmonised European standard(s) or by using the other conformity assessment procedures set out in the R&TTE Directive;

DECIDES

1. that this ECC Decision defines harmonised conditions for the use in CEPT countries of Building Material Analysis (BMA) devices using UWB technology;
2. that devices permitted under this Decision are defined as field perturbation sensors that are designed to detect the location of objects within a building structure or to determine the physical properties of a building material;
3. that the devices permitted under this ECC Decision are exempt from individual licensing and operate on a non-interference, non-protected basis;
4. that the technical requirements detailed in Annex 1 and 2 apply to BMA devices permitted under this ECC Decision;
5. that this Decision enters into force on 30 March 2007;
6. that the preferred date for implementation of this Decision shall be 1 October 2007;
7. that CEPT administrations shall communicate the national measures implementing this Decision to the ECC Chairman and the Office when the Decision is nationally implemented;
8. that based on the experience gained a review of this Decision should take place in 2010.”

Note:

1. The following Members have a derogation to implement this Decision until [date]:
2. *Please check the Office web site (<http://www.ero.dk>) for the up to date position on the implementation of this and other ECC decisions.*

ANNEX 1

Technical requirements for Building Material Analysis (BMA) devices using UWB technology

1. BMA Devices permitted under this Decision shall fulfil the following requirements:
 - a) Transmitter-On only if manually operated with a non-locking switch (e.g. it may be a sensor for the presence of the operators hand) plus being in contact or close proximity to the investigated material and the emissions being directed into the direction of the object (e.g. measured by a proximity sensor or imposed by the mechanical design);
 - b) The BMA transmitter has to switch-off after max 10s without movement;
 - c) The Total Radiated Power spectral density (Definition at the end of Annex 1) has to be 5 dB below the maximum mean e.i.r.p. spectral density limits in Table 1;
2. Any undesired emissions emanating from BMA devices permitted under this decision shall be kept to a minimum and in any case not exceed the e.i.r.p. spectral density limits within the following Table 1. The compliance with the limits of Table 1 has to be ensured with the BMA device on a representative wall (see Definition at the end of Annex 1).

Frequency range	Maximum mean e.i.r.p. spectral density	Maximum peak e.i.r.p. (measured in 50 MHz)
Below 1.73 GHz Note 1	-85 dBm/MHz	-45 dBm
1.73 to 2.2 GHz	-65 dBm/MHz	-25 dBm
2.2 to 2.5 GHz	-50 dBm/MHz	-10 dBm
2.5 to 2.69 GHz Note 1	-65 dBm/MHz	-25 dBm
2.69 to 2.7 GHz Note 2	-55 dBm/MHz	-15 dBm
2.7 to 3.4 GHz Note 1	-82 dBm/MHz	-42 dBm
3.4 to 4.8 GHz	-50 dBm/MHz	-10 dBm
4.8 to 5 GHz Note 2	-55 dBm/MHz	-15 dBm
5 to 8 GHz	-50 dBm/MHz	-10 dBm
8 to 8.5 GHz	-70 dBm/MHz	-30 dBm
Above 8.5 GHz	-85 dBm/MHz	-45 dBm

Table 1

Note 1: devices using a Listen Before Talk (LBT) mechanism, as described in the harmonised standard EN 302 435, which meets the technical requirements defined within Annex 2 of this Decision, are permitted to operate in frequency range 1.215 to 1.73 GHz with a maximum mean e.i.r.p. limit of -70 dBm/MHz e.i.r.p. and a maximum peak limit of -30 dBm/50MHz e.i.r.p. and from 2.5 to 2.69 and 2.7 to 3.4 GHz with a maximum mean e.i.r.p. limit of -50 dBm/MHz e.i.r.p. and a maximum peak limit of -10 dBm/50MHz e.i.r.p.

Note 2: to protect the RAS bands 2.69 to 2.7 GHz and 4.8 to 5 GHz, the Total Radiated Power spectral density has to be below -65 dBm/MHz.

OTHER REQUIREMENTS

 Pulse Repetition Frequency (PRF)

The pulse repetition frequency (PRF) for pulsed UWB devices shall not be less than 5MHz. This restriction does not apply to burst repetition frequency.

DEFINITIONS

 Maximum mean e.i.r.p. spectral density

The highest signal strength measured in any direction at any frequency within the defined range. The mean e.i.r.p. spectral density is measured with a 1MHz resolution bandwidth, an RMS detector and an averaging time of 1ms or less.

 Maximum peak e.i.r.p.

The highest signal strength measured in any direction at any frequency within the defined range. The peak e.i.r.p. is measured within a 50MHz bandwidth centred on the frequency at which the highest mean radiated power occurs.

 Total Radiated Power spectral density

The average of the mean e.i.r.p. spectral density values measured over a sphere around the measurement scenario with a resolution of at least 15 degree. The detailed measuring setup is contained within ETSI EN 302 435.

 Undesired emissions

That for the purpose of this Decision, “undesired emissions” are defined as those emissions radiated in all directions from the BMA equipment, including direct emissions of the equipment and emissions reflected or passing through the media under inspection.

 Representative wall

The radiations into the air as a result of the operation of BMA systems are highly dependent on the operational conditions and are only meaningful if coupled with the material being investigated; therefore a measurement scenario with a representative wall is necessary and is defined within ETSI EN 302 435; the representative wall has to meet the wall attenuation values within Table 2 of this Decision:

Frequency GHz	Wall attenuation values for the representative wall dB		
	min	average	max
1	5	7	9
2	8	10	12
3	10	12	14
4	12	14	16
5	14	16	18
6	16	18	20
7	18	20	22
8	20	22	24

Table 2

ANNEX 2

Technical requirements of the “Listen Before Talk” mechanism

1. Peak power threshold value for the “Listen Before Talk” mechanism to ensure the protection of the listed services are defined within Table 3 below.

Frequency range	Radio service to be detected	Peak power threshold value
1.215 - 1.4 GHz	Radiodetermination Service	+8 dBm/MHz
1.61 - 1.66 GHz	Mobile Satellite service	-43 dBm/MHz
2.5-2.69 GHz	Land Mobile service	-50 dBm/MHz
2.7 - 3.4 GHz	Radiodetermination Service	-7 dBm/MHz

Table 3

2. Additional requirements for Radar detection: Continuously listening and automatic switch-off within 10ms, if a threshold value is exceeded; in the case of detecting and switching off the transmitter, a silent time of at least 12s while listening continuously is necessary before the transmitter can be switched on again. This silent time during which the LBT receiver is active has to be ensured even after the device is switched off by the functions described in Annex 1 2a, the proximity sensor and manual operation.