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World-wide regulation and standardisation overview

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Abstract

This document provides a detailed overview over the actual status in the UWB regulation and standardisation domain worldwide.
It summarises the existing requirements valid today for the products intended to be launched in the different markets in the regions of the world.

Based on this status it can be derived what kind of actions have to be undertaken to harmonize the products for the individual markets or what individual national regulatory framework should be tried to be adapted to fit the technical requirements.

Keywords

UWB, standardisation, regulation, ETSI, CEPT, APT, FCC, ITU

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Abbreviations

APT	Asian Pacific Telecommunity
CEPT	Committee on European Postal Regulations
DAA	Detect And Avoid
EC	European Commission
ECC	European Communication Committee
EIRP	Equivalent isotropically radiated power
ERO	European Radiocommunication Office
EUWB	CoExisting Short Range Radio by Advanced Ultra-WideBand Radio Technology
FCC	Federal Communication Commission
IDA	Infocomm Devlopment Authorithy
ITU	International Telecommunication Union
LDC	Low Duty Cycle
LDR	Low Data Rate
MB-OFDM	Multi-Band OFDM
OFDM	Orthogonal Frequency Division Multiplexing
RSC	Radio Spectrum Committee
UWB	Ultra-Wideband
UWB-RT	Ultra-Wideband Radio Technology
WGFM	Working Group Frequency Management (sub group of CEPT ECC)
WGSE	Working Group Spectrum Engineering (sub group of CEPT ECC)
WiMAX	Worldwide Interoperability for Microwave Access
WiMAX UL	WiMAX Uplink

1 Executive summary

This document provides a detailed overview over the actual status in the UWB regulation and standardisation domain.

It takes into account the status in Europe with priority.

Followed by the situation in the US and Asia. Because any one has to have in mind that for the European companies involved in this project, the world wide market is necessary to be addressed too.

A specific focus will be put onto the running activities with the corresponding cross relations to the EUWB application and research areas. This simplifies the efficient information flow and initiation of the needed requirement inputs from the application and research WPs.

Based on this status report a regulation and standardisation plan will be created. This plan will be structured according to the applications and research areas covered in EUWB and will be provided to all WPs in UWB. It will be updated on a regular base and released then again in M18 and M27 based on inputs from the EUWB WPs and external regulatory and standardisation activities.

The further activities in regulation and standardisation will be planned based on this living report.

2 Introduction

The introduction of a new radio technology, especially when it is a wide band technology has to take into account the existing regulatory frame works in the different regions of the world.

The existing traditional radio services have occupied the radio frequency resources they need to perform their intention since a relative long time.

Between 9 kHz and 300 GHz is no radio spectrum available, which is not already allocated by one or more radio services.

The national authorities (ministries, governments) control these physically limited radio spectrum resources to establish a harmonized access and usage. And if there is an financial income for the government due to a licensing scheme , it is seen as a positive aspect.

It is a kind of natural rule that an existing socio or economic status is tried to be kept as long as possible as it is or if the pressure is high enough to keep the changes as small as possible.

The industry intending to use UWB as a wide band radio technology has to be aware that in a first step the regulatory aspects for the frequency band they intend to use and which is already occupied by certain radio services can be used.

This is done

in Europe by a process agreed between ETSI as the standardisation body and the CEPT , namely WGFM.

in the US a similar construction of working split is established between the FCC and the NTIA.

in Asia the situation is more complex: there APT is a board where the national administrations are working together on an informal way (similar to CEPT ECC but without any binding decisions). Outputs are more or less recommendations or statements from individual countries.

Regulatory and standardisation activities are time consuming and are evolutionary in the view of adoption of the frequency allocation. The status report out of PULSERS II for these aspects is still valid for most of the regulatory frameworks existing in most of the countries.

3 Regulation in Europe

3.1 Generic UWB regulation

3.1.1 ECC Decisions on generic UWB devices

Decision ECC/DEC/(06)04 on the harmonised conditions for devices using UWB technology in bands below 10.6 GHz was adopted by the ECC at its meeting March 2006.

This ECC Decision was primarily intended to respond to the market demand for UWB indoor and handheld devices providing communication applications. Some categories of UWB devices characterized by predominantly outdoor usage and which are listed below were however explicitly excluded from the scope of this regulation as they could present a significant risk of interference to radio services deployed outdoor:

- Installations in road and rail vehicles
- Fixed outdoor installations
- Installations in flying models, aircraft and other aviation

It was agreed that further technical studies would still be needed in several areas in order to finalize generic regulatory solutions for UWB operation in Europe, in particular concerning maximum mean e.i.r.p. spectral densities in the bands 2.7 – 3.8 GHz and 8.5 – 9 GHz, Detect And Avoid (DAA) and Low Duty Cycle (LDC) mitigation techniques and UWB installations in road and rail vehicles.

As requested by the ECC meeting July 2006, a report on the regulatory and enforcement implications of a possible harmonized transition measure (phased approach) applicable to frequency band 4.2 – 4.8 GHz was also developed. Such a phased approach would mean that the first generation (1G) of UWB devices operating in the 4.2 – 4.8 GHz frequency band with a maximum mean e.i.r.p. spectral density of –41.3 dBm/MHz without additional mitigation is introduced earlier in Europe, and after a cut-off date (31 December 2010) it will gradually be replaced with the second generation (2G) of UWB devices implementing a mandatory requirement for additional mitigation.

Decision ECC/DEC/(06)04 was finally amended July 2007 so as to reflect the outcome of these further studies on UWB.

Decision ECC/DEC/(06)12 on the harmonised conditions for devices using Ultra-Wideband (UWB) technology with Low Duty Cycle (LDC) in the frequency band 3.4 – 4.8 GHz was adopted by the ECC at its meeting December 2006 and has not been amended so far.

Current “generic regulation for UWB devices” from CEPT consisting of Decisions ECC/DEC/(06)04 and ECC/DEC/(06)12 has been proposed to evolve into the following:

- One baseline Decision (i.e. ECC/DEC/(06)04) meant to provide a stable picture of the European spectrum mask for generic UWB devices without the requirement for additional mitigation.
- One Decision on complementary provisions (LDC, DAA…) to this baseline Decision, which by nature could be more subject to changes.

3.1.2 Review of regulatory provisions for generic UWB devices

Beyond the core market demand for communication applications and cable replacement technology, recent work within CEPT has shown the interest from industry for operating various types of applications (e.g. location-tracking, sensor technologies…) under the generic UWB regulation.

CEPT/ECC TG3 has undertaken in this context a detailed review of regulatory provisions for generic UWB devices that addresses all type of devices or installations including those categories of installations that were originally excluded from the scope of Decision ECC/DEC/(06)04.

The amendments that have been recently agreed for Decision ECC/DEC/(06)04 and those that are planned for ECC/DEC/(06)12 as well as their implications for the related Commission Decision of 21 February 2007 (2007/131/EC) are detailed in Attachment 1 to this document.

This analysis considers the applicability of the spectrum mask for generic UWB devices, and of the requirements for DAA and LDC mitigation techniques for each of the following categories:

- All applications (except installations listed below)
- Installations in road and rail vehicles
- Fixed outdoor installations
- Installations in flying models, aircraft and other aviation

3.1.3 Impact of ongoing CEPT technical studies on Commission Decision of 21 February 2007 (2007/131/EC)

3.1.3.1 Progress status

The CEPT technical studies distinguish clearly the cases of installations in road and rail vehicles, fixed outdoor installations and installations in flying models, aircraft and other aviation.

The table below provides a progress status of the CEPT complementary technical studies that are likely to impact Commission Decision on generic UWB (2007/131/EC):

**Categories **	**Power level**	**LDC operation**	**DAA operation**
All applications except…	Existing provisions (2007/131/EC): - Spectrum mask Complementary studies : - Power level in the bands 2.7 – 3.4 GHz, 3.4 – 3.8 GHz and 8.5 – 9 GHz	Existing provisions (2007/131/EC): - LDC operation in the band 3.4 – 4.8 GHz Complementary studies : - LDC operation in the Band 3.1 – 3.4 GHz	Existing provisions (2007/131/EC): - *Not explicitly included* Complementary studies : - DAA operation in the bands 3.1 – 3.4 GHz, 3.4 – 4.8 GHz(1) and 8.5 – 9 GHz

	Status / Target : - **Completed**	Status / Target : - **Measurement campaign scheduled 20 – 22 February 2008. completed**	Status / Target : - **Draft ECC Report to be submitted to ECC March 2008 for adoption for public consultation** - **Amendment of ECC/DEC/(06)12 subject to consideration of *DAA measurement procedures* from ETSI presented at TG3#23 meeting May 2008.**
Installations in road and rail vehicles	Existing provisions (2007/131/EC): - *Not included* Complementary studies : - Power level in the bands 4.2 – 4.8 GHz and 6 – 8.5 GHz for operation in vehicles Status / Target : - **Completed**	Existing provisions (2007/131/EC): - *Not included* Complementary studies : - Requirements for LDC operation in vehicles Status / Target : - **Completed**	Existing provisions (2007/131/EC): - *Not included* Complementary studies : - Requirements for DAA operation in vehicles Status / Target : - **Completed**
Fixed outdoor installations	Existing provisions (2007/131/EC): - *Not included* Complementary studies : - Power level in the bands 4.2 – 4.8 GHz and 6 – 8.5 GHz for operation at fixed outdoor location Status / Target : - **Completed**	Existing provisions (2007/131/EC): - *Not included* Complementary studies : - Requirements for LDC operation at fixed outdoor location Status / Target : - **Completed**	Existing provisions (2007/131/EC): - *Not included* Complementary studies : - Requirements for DAA operation at fixed outdoor location Status / Target : - **Completed**
Installations in flying models, aircraft and other aviation	Existing provisions (2007/131/EC): - *Not included in the scope of the EC Decision / subject to appropriate sector regulation* Complementary studies : - No complementary studies planned within CEPT		

(1) Technical studies are limited to the band 3.4 – 3.8 GHz.

Table 3-1: Impact of ongoing CEPT technical studies

3.1.3.2 Schedule of work: summary

The progress on the complementary CEPT technical studies performed in order to finalise the work on generic UWB can be summarized as follows:

- Spectrum mask: the definition of maximum power levels without requirement for additional mitigation has been completed with the amendment of Decision ECC/DEC/(06)04 agreed by ECC at its meeting July 2007.

- Specific regulatory provisions for certain categories of UWB devices characterized by predominantly outdoor usage (installations in vehicles & aircrafts, fixed outdoor installations): complementary studies completed December 2007.

- LDC mitigation technique: technical studies are completed by a measurement campaign scheduled 20 – 22 February 2008 in Aurich (Germany) in order to finally assess the impact of "pulse-like" UWB LDC devices on S-band Radars. ECC TG3 considers at its meeting May 2008 the possible inclusion of regulatory provision for LDC operation in the band 3.1 – 3.4 GHz in Decision ECC/DEC/(06)12.

- DAA mitigation technique:

The draft ECC Report on DAA mitigation technique was approved by ECC meeting March 2008 for public consultation.

Due to the specificity of "detection mechanism" associated with DAA mitigation technique, it has however to be emphasized that the *DAA technical parameters* alone (to be included the ECC Report) do not ensure protection of radio services by themselves. This has to be completed with adequate *DAA measurement procedures* in the related ETSI standard.

The final validation of DAA mitigation technique from ECC TG3 view point will take into consideration *DAA measurement procedures* from ETSI. A close cooperation between CEPT ECC TG3 and ETSI organisations has been established on such issues.

Specific concerns were raised on proposed technical requirements for DAA operation in the band 8.5 – 9 GHz as these may not be effective in case of low power radars. In addition, passive radar systems may be deployed in the future and DAA mechanism is not suitable for these radar systems.

3.2 Specific UWB regulation

3.2.1 General considerations

CEPT Report 10 provides a summary of general principles for the development of regulations for specific UWB applications and benefits of using UWB technology for this type of applications.

A number of difficulties of technical, regulatory and enforcement nature associated with the multiplication of specific UWB applications are underlined. It is concluded in particular that strong justification is needed for developing specific UWB regulations, which can be envisaged only for "niche applications". It was also argued that the notion of "undesired emissions", which is inherent to most specific UWB applications considered initially by CEPT, could to some extent justify that these applications cannot fit within the generic regulation. Key differences in the principles behind the generic UWB regulation and specific regulations for Ground- and Wall- Probing Radar (GPR/WPR) imaging systems and Building Material Analysis (BMA) devices are presented below:

- The generic UWB regulation defines a spectrum mask applicable to a stand-alone radio device. For a communication application, the maximum e.i.r.p. density and frequency band will typically govern the maximum operating range for a given data rate. For a sensor-like application (e.g. movement detection, location-tracking…), it will typically govern the maximum operating range for a given resolution/accuracy.

- The "undesired emissions" from a specific UWB application are highly dependent on the operational conditions and are only meaningful when coupled with the material being investigated. Their reduction is a specific design task for the manufacturers and may e.g. necessitate appropriate shielding of the device. It does not necessarily affect the performance of the application.

Requirements from the industry for specific UWB applications ought obviously to be considered for applications with clear benefits from using UWB technology that cannot fit under the generic Decision on UWB. The use of UWB technology in accurate imaging applications is expected to be the main application for which a specific UWB regulation could be developed because of physical reasons (e.g. lower frequencies with higher levels are needed due to reflections of clutter and the needed penetration depth).

Recognizing the benefits offered by UWB technology in providing "accuracy in imaging applications", ECC developed and approved the following Decisions:

- ECC Decision of 1 December 2006 on the conditions for use of the radio spectrum by Ground- and Wall- Probing Radar (GPR/WPR) imaging systems (ECC/DEC/(06)08)
- ECC Decision of 30 March 2007 on Building Material Analysis (BMA) devices using UWB technology (ECC/DEC/(07)01)

3.2.2 Imaging applications using UWB-RT: definition

CEPT Report 10 defines imaging applications as applications for the purpose of detecting or obtaining the images of objects buried into the ground or contained within a ''wall'', or of determining the

physical properties within the ground or a ‘‘wall’’; the ‘‘wall’’ being a concrete structure, the side of a bridge, the wall of a mine or another physical structure that is dense enough and thick enough to absorb the majority of the signal transmitted by the imaging system.

The following definitions have been used in the ECC Decisions on GPR/WPR imaging systems and BMA devices:

Decision ECC/DEC/(06)08:

- *Ground probing radar (GPR) imaging system. A field disturbance sensor that is designed to operate only when in contact with, or within one meter of, the ground for the purpose of detecting or obtaining the images of buried objects or determining the physical properties within the ground. The energy from the GPR is intentionally directed down into the ground for this purpose.*
- *Wall probing radar (WPR) imaging system. A field disturbance sensor that is designed to detect the location of objects contained within a "wall" or to determine the physical properties within the "wall". The "wall" is a concrete structure, the side of a bridge, the wall of a mine or another physical structure that is dense enough and thick enough to absorb the majority of the signal transmitted by the imaging system;*

Decision ECC/DEC/(07)01 :

- *Building Material Analysis (BMA) devices 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;*

CEPT has developed regulations for 3 kinds of applications:

- GPR ("licensed")
- WPR ("licensed")
- BMA ("unlicensed")

All three basically aim to detect the location of objects contained within a structure or to determine the physical properties of a material, following the same physical principles.

The regulatory solutions that have been developed can be presented as follows:

- *"Wall" imaging radar applications*

WPR and BMA applications are basically the same. Two different sets of regulation have been agreed:

- "*unlicensed*", subject in some frequency bands to the implementation of adequate mitigation techniques;
- "*licensed*", allowing some higher radiated spectral power densities in certain frequency bands subject to adequate coordination procedures.

- *Ground imaging radar applications*

Only a "*licensed*" regulatory regime has been agreed.

It has however to be emphasized that CEPT has considered predominantly the type of regulatory regime as key discriminating factor.

3.2.3 Compatibility studies

Technical studies on GPR/WPR imaging systems are detailed in **Doc. ECC(06)016 Annex 2**.

Technical studies on BMA devices are detailed in **Doc. ECC (06)061 Annex 21**.

The following table clarifies the key compatibility constraints that govern the maximum mean e.i.r.p. spectral densities set in the regulations for GPR/WPR and BMA:

Frequency range	**Generic UWB** **Decision (06)04**	**GPR/WPR imaging systems** **Decision (06)08**	**BMA devices** **Decision (07)01**	**Comments on compatibility / constraining issues**
Below 1.215 GHz	-90	-65 / -60	-85	Broadcasting • GPR/WPR: -65 dBm/MHz e.i.r.p. in the VHF band (174-230 MHz) and -60 dBm/MHz e.i.r.p. in the UHF band (470-862 MHz) ensures a noise floor degradation of less than 3 dB of the DVB-T receivers at a distance greater than 20 m. • BMA: maximum mean e.i.r.p. spectral density close to generic UWB limit
1.215 - 1.6 GHz	-90 / -85	-65	-70 + LBT	EESS in the band 1400-1427 MHz • GPR/WPR: -65 dBm/MHz e.i.r.p. ensures the protection of EESS sensors from a single interferer (assuming 0.01 K future sensors sensitivity and 1% apportionment criteria). • BMA: -70 dBm/MHz e.i.r.p. acceptable for aggregate interference analysis, taking into account the additional -75 dBm/MHz e.i.r.p. Total Radiated Power (TRP) limit. RNSS in the bands 1164-1215 MHz and 1559-1610 MHz • GPR/WPR: -68 dBm/MHz required for the protection of RNSS receivers when assuming 6m separation distance (NB: 1m was assumed for generic UWB regulation) and

1 Further work performed by correspondence at the request from ECC to investigate means for the protection of radio astronomy under the assumption of licence-exempt devices is detailed in Doc. TG3#18_06R1.

Frequency range	**Generic UWB** **Decision (06)04**	**GPR/WPR imaging systems** **Decision (06)08**	**BMA devices** **Decision (07)01**	**Comments on compatibility / constraining issues**
				UWB noise-like emission; maximum -75 dBm/kHz e.i.r.p. applies also in case of spectral lines. • BMA: -70 dBm/MHz e.i.r.p. acceptable for aggregate interference analysis, taking into account the additional -75 dBm/MHz e.i.r.p. Total Radiated Power (TRP) limit. <u>Aeronautical radars</u> • GPR/WPR: -65 dBm/MHz e.i.r.p. ensures a protection distance of about 2.3 km for 1.3 GHz ground based aeronautical radars. Effective protection can be achieved through adequate coordination procedures. • BMA: protection of radars subject to the effectiveness of LBT mechanism.
1.73 to 2.2 GHz	-85	-51.3	-65	*No critical interference scenario identified for GPR/WPR and BMA.*
2.2 to 2.5 GHz	-85	-51.3	-50	BMA: 2.2 GHz is the lower frequency edge requirement for operation at -50 dBm/MHz e.i.r.p.
2.5 to 2.69 GHz	-85	-51.3	-50 + LBT	<u>IMT-2000</u> • BMA: IMT-2000 at 2.6 GHz identified as a critical interference scenario with mobile station (taking into account BMA operational requirement at -50 dBm/MHz e.i.r.p. and expected deployment). Protection of mobile terminal station subject to the effectiveness of LBT mechanism.
2.69 to 2.7 GHz	-85	-51.3	-55 & -65 TRP	<u>Radio astronomy</u> • GPR/WPR: effective protection can be achieved through adequate coordination procedures. • BMA: identified as critical interference scenario (1.3km estimated protection distance at 2.7 GHz). Administrations are encouraged to monitor the impact of BMA on radiocommunication services, especially on RAS.
2.7 to 3.4 GHz	-70	-51.3	-50 + LBT	<u>Meteorological radar</u> • GPR/WPR: -51 dBm/MHz e.i.r.p. ensures a protection distance of up to 3.8 km for 2.8 GHz meteo radars (-41 dBm/MHz would lead to more than 9 km when assuming I/N = -10 dB). Operation subject to adequate coordination procedures. • BMA: protection subject to the effectiveness of LBT mechanism.
3.4 to 3.8 GHz	-80	-41.3	-50	*No critical interference scenario identified for GPR/WPR and BMA.*
3.8 to 4.2 GHz	-70	-41.3	-50	*No critical interference scenario identified for GPR/WPR and BMA.*
4.2 to 4.8 GHz	-70 (-41.3)	-41.3	-50	*No critical interference scenario identified for GPR/WPR and BMA.*
4.8 to 5 GHz	-70	-41.3	-55 & -65 TRP	<u>Radio astronomy</u> • GPR/WPR: effective protection can be achieved through adequate coordination procedures. • BMA: identified as critical interference scenario (700m

Frequency range	**Generic UWB** **Decision (06)04**	**GPR/WPR imaging systems** **Decision (06)08**	**BMA devices** **Decision (07)01**	**Comments on compatibility / constraining issues**
				estimated protection distance at 4.9GHz). Administrations are encouraged to monitor the impact of BMA on radiocommunication services, especially on RAS.
5 to 6 GHz	-70	-51.3	-50	Meteorological radar • GPR/WPR: -51 dBm/MHz e.i.r.p. ensures a protection distance in the order of 0.5 km for 5.6 GHz meteo radars (-41 dBm/MHz would lead to around 5-6 km when assuming I/N = -10 dB). • BMA: acceptable level of protection taking into account BMA specific deployment scenarios, mitigation factors and additional propagation losses compare with L-band (1.2 GHz) and S-band (3 GHz) radars.
6 to 8 GHz	-41.3	-65	-50	GPR/WPR: the development of systems operating above 6 GHz is not anticipated in the short/medium term. BMA: 8 GHz is the upper frequency edge requirement for operation at -50 dBm/MHz
8 to 8.5 GHz	-41.3	-65	-70	-
8.5 to 9 GHz	-65	-65	-85	-
9 to 10.6 GHz	-65	-65	-85	-
Above 10.6 GHz	-85	-65	-85	-

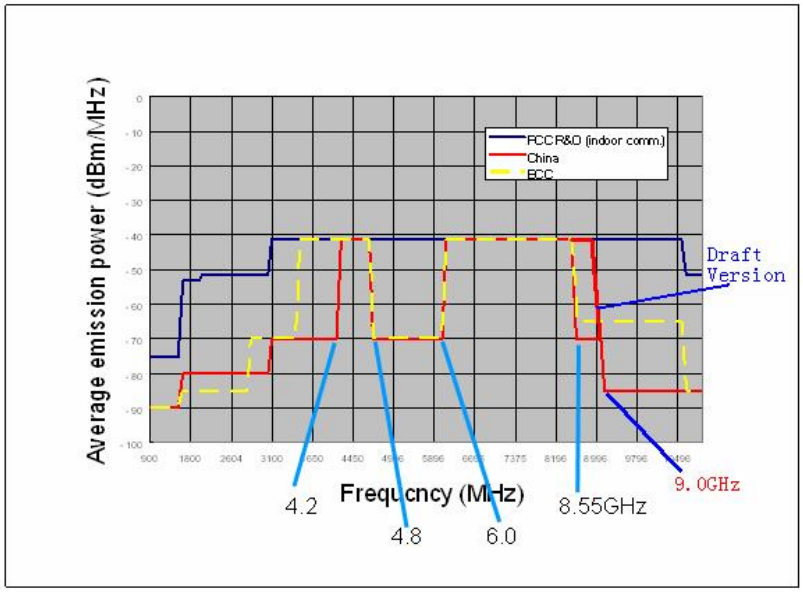
Table 3-2 : Compatibility constraints specific UWB applications

Finally, CEPT technical clarifications on peak and mean power limits GPR/WPR imaging systems in Decision ECC/DEC/(06)08 provided in document RSCOM07-31 (see also Doc. ECC(07)051) should also be mentioned.

4 Spectrum Regulation Status in Asia

4.1 China

MII (Ministry of Information and Industry –combined into Ministry of Industry and Information Technology of the People's Republic of China) has issued a public call for comments on the draft UWB regulation from May, 28th, 2008 -- Sep, 30th, 2008



Freq (GHz)	Max EIRP (dBm/MHz)	Detection system
<1.6GHz	-90	Effective value (RMS)
1.6-3.6GHz	-85	
3.6-6.0GHz (**note**)	-70	
6.0-9.0	-41.3	
9.0-10.6	-70	
>10.6GHz	-85	

Figure 4-1:Chinese spectrum mask compared to FCC and ECC regulation

- The UWB in band transmission is restricted to the frequency range of 4.2~4.8GHz and 6.0~9.0GHz;
- Device using UWB technology which has UWB transmission in 4.2~4.8GHz is restricted to be used in door.
- Device using UWB technology which has UWB transmission in 6.0~9.0GHz can be used both in door and out door.
- Any UWB radiation from the device using UWB technology (including in band transmission and out of band emission) should meet the requirement list in the table above.

Note: In 4.2-4.8GHz, the max EIRP can be restricted to -41.3dBm/MHz by the date of 31th Dec, 2010. After that, the UWB devices shall adopt the Interference Relief Technology, such as DAA (Detect and Avoid). The effectivity of this technology shall be identified by the State Radio Administrations (SRRC).

China UWB Regulation Research

- **Frequency Interference and Protection serial projects in China**
  - CCSA (China Communications Standards Association) Projects (completed by end of 2007)
  - Include 4 fields: “UWB and IMT-2000 FDD”, “UWB and IMT-Advanced (3-6GHz)”, “UWB and GSM”, and “UWB and TD-SCDMA”
  - Supported by: SRMC (State Radio Monitoring Center), ICRC (Intel China Research Center), CATR (China Academy of Telecommunication Research of MII), Datang Mobile (Datang Mobile Communications Equipment Co., Ltd) and NSN (Nokia Siemens Networks)
  - Goal: to do research on interference and protection between UWB and other wireless technology, get UWB PSD values in UWB and other wireless technology coexistence, and give reference for China UWB Spectrum.

Victim System	Victim Frequency bands (MHz)
IMT-2000 FDD	1755-1785
	1850-1880
	1920-1980
	2110-2170
	2500-2570
	2620-2690
GSM	1710-1755
	1805-1850
TD-SCDMA	1880-1920
	2010-2025
	2300-2400
	2570-2620
IMT-Advanced	3100-3800
	3800-4800
	4800-6000

Table 4-1 : China UWB Regulation Research

4.2 Japan

The preliminary mask for UWB was announced in September 2005.

Established on Dec. 12th, 2006 by MIC (Ministry of Internal Affairs and Communications)

DAA is TBD…use CEPT TG3 as baseline and modify for Japan as needed

Freq (GHz)	**Max EIRP (dBm/MHz)**
f ≤ 1.6	-90
1.6 < f ≤ 2.7	-85
2.7 < f ≤ 3.4	-70
3.4 < f ≤ 4.8 (devices using DAA)	-41.3
3.4 < f ≤ 4.2 (devices not using DAA)	-70
4.2 < f ≤ 4.8	-41.3
4.8 < f ≤ 7.25	-70
7.25 < f ≤ 10.25	-41.3
10.25 < f ≤ 10.6	-70
10.6 > f > 10.7	-85
10.7 > f > 11.7	-70
11.7 > f > 12.75	-85
f > 12.75	-70

Table 4-2 : Japan PSD emission

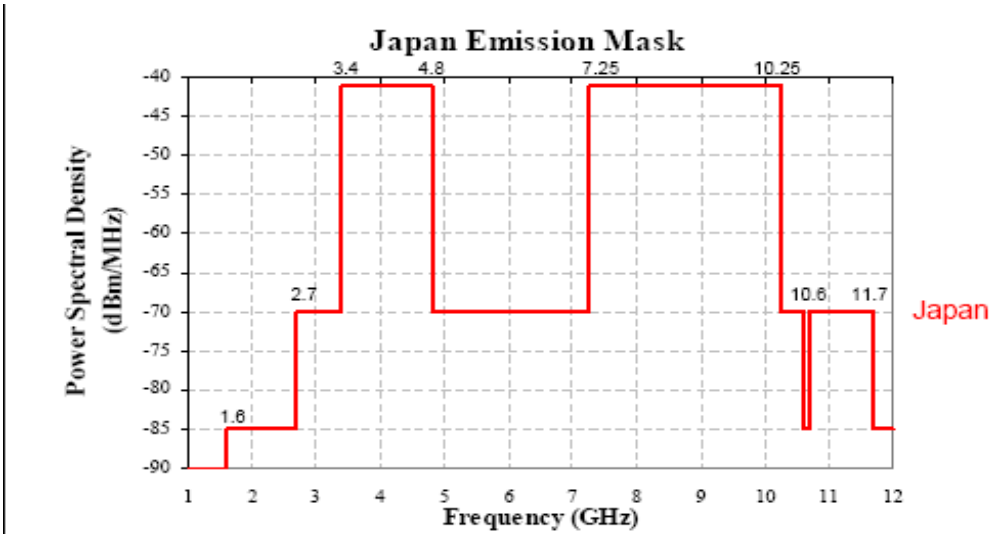


Figure 4-2: Japanese spectrum mask

The band 3.1 – 3.4GHz is restricted in order to protect RAS (3.3GHz)

- Compatibility studies show that UWB devices operating in the 3.4-4.2 GHz band should incorporate interference mitigation techniques. The band 3.4 – 4.2GHz is licensed for satellite (downlink) communication operators, and requires DAA. Satellite links are rapidly replaced with fibers, and regulation is planned to be reviewed
- The band 4.2 – 4.8GHz is nationally reserved for the future 4G use, and requires DAA. Without DAA, the emission power is limited to -70dBm/MHz or less. DAA is waived until December 31, 2008. Due to the WRC-07 decision, there is no global use of 4.2 – 4.8GHz for 4G, and the ministry (MIC) is currently considering the extension of the time limit
- The band 6.0 – 7.25GHz is licensed to EESS and TV news gathering use, and its use is restricted

4.3 Korea

UWB regulation done by MIC (Ministry of Information and Communication Republic of Korea) in July, 2006:

Freq (GHz)	**Max EIRP (dBm/MHz)**
$f \leq 1.6$	-90
$1.6 < f \leq 2.7$	-85
$2.7 < f \leq 3.1$	-70
$3.1 < f \leq 4.8$ (devices using DAA)	-41.3
$3.1 < f \leq 4.2$ (devices not using DAA)	-70
$4.2 < f \leq 4.8$	-41.3

4.8 < f ≤ 7.2	-70
7.2 < f ≤ 10.2	-41.3
f > 10.2	-70

Table 4-3 : Korean PSD

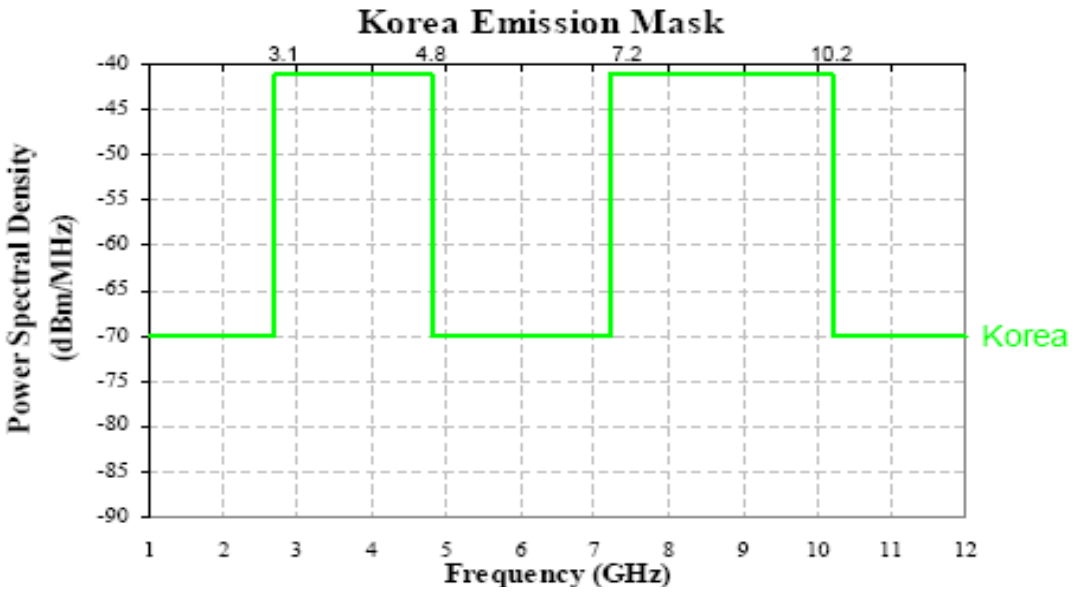


Figure 4-3: Korean spectrum mask

- For Korea, the spectrum allocation for UWB starts in the frequency band from 3.1 to 10.2 GHz, similar to bands allocated by FCC, but uses a different emission mask to accommodate its spectrum environment in Korea. Considering the importance of harmful interference avoidance to IMT-Advanced system and broadcasting relay system, Korea requires use of Detect and Avoid (DAA) technology for the UWB devices operating in the 3.1 to 4.2 GHz band from April 2007, and for those operating in the 4.2 to 4.0 MHz band from July 2010. Without DAA in 3.1 – 4.8GHz band , the emission power is limited to -70dBm/MHz or less.
- DAA (under study)

  Mechanism is studied to mitigate the emission power to less than -70dBm/MHz within two seconds when a signal stronger than - 80dBm/MHz is detected.
- The 6.0 – 7.2GHz band is protected for the licensed services.

Japan & Korea UWB Regulation Research

- **ARIB (Association of Radio Industries and Businesses)**
  - An interference study was conducted with respect to the following services:
    - Radars, Satellites (passive and BTS), cell phones (3G and 4G), FS, EESS, RAS, Broadcasting, WLAN, Amateur radios and DSRC.

- Interference measurement was conducted for Satellite BTS, cell phones (W-CDMA, CDMA2000, PHS), FS, WRAN for both impulse-based UWB and WiMedia UWB
- UWB industry, in parallel, worked on a UWB Standards And Users Guide as ARIB standard, STD-T91. ARIB is currently (2008) drafting a revision of T91 and a standard for wireless 1394 over UWB.

- **NICT (National Institute of Information and Communications Technology)**
  - NICT started to research UWB technologies in 2002, and organized the UWB consortium in cooperation with more than 20 companies and 6 universities in Japan.
  - Before, mainly including developing MMIC chips, UWB antennas and UWB testbed, measuring UWB signal propagation
  - A new project to investigate DAA is currently being considered
- **Korea UWB Forum**
  - The forum was dedicated to collecting voices from various expert groups including potential UWB user groups, interference victim groups, technical experts, spectrum management experts and administration officers.

5 UWB spectrum regulation status in USA

In USA the FCC approved UWB emission mask since 2002. The following figure gives the emission mask for communications devices in an indoor environment. For generic UWB devices a maximum mean EIRP of -41.3 dBm/MHz is authorized between 3.1 GHz and 10.6 GHz.

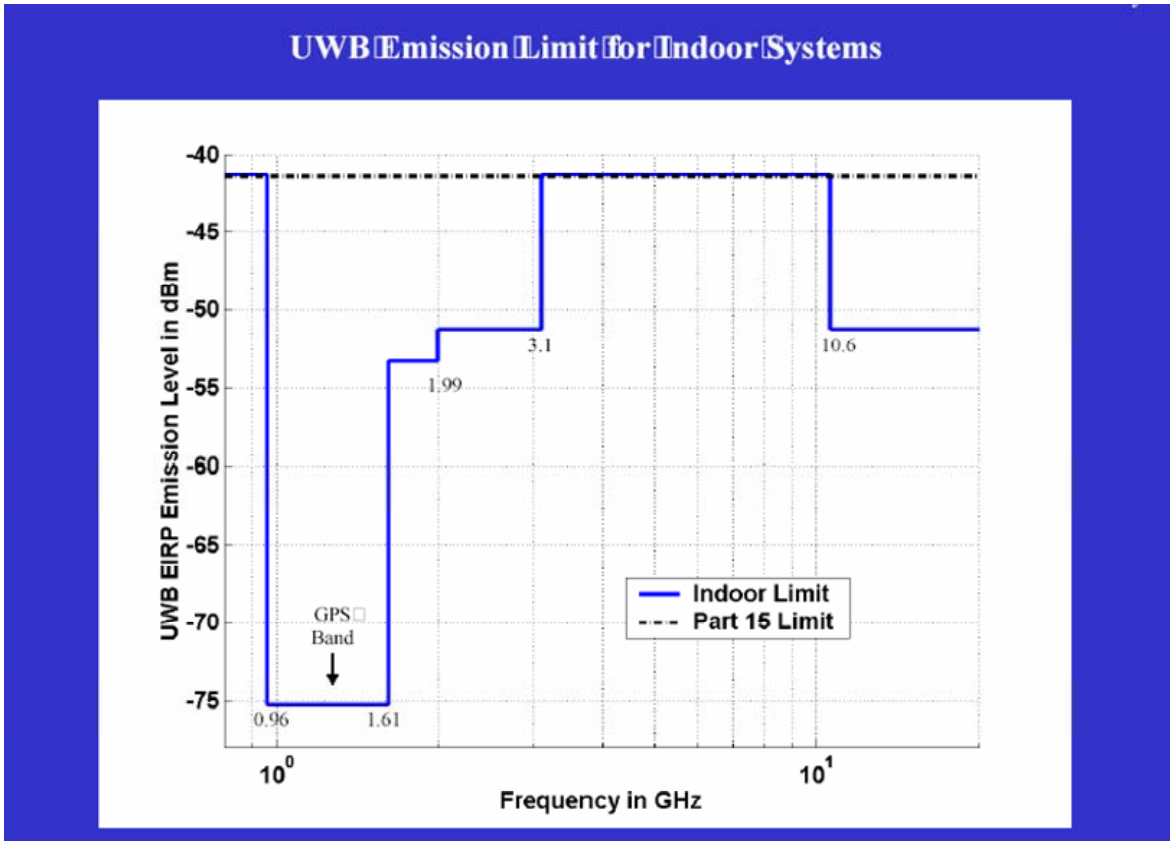


Figure 5-1: US spectrum mask (FCC)

6 Conclusion

6.1 Conclusion on generic UWB regulation

Taking into account the current trends of future UWB market devices, CEPT has undertaken several complementary studies, involving industry stakeholders, in order to finalize the work on generic UWB. Most of these studies have been completed by March 2008.

The validation of DAA mitigation technique from regulatory perspective will however require beyond this timeline consideration of *DAA measurement procedures* from ETSI. This overall process relies on a close cooperation between CEPT and ETSI organisations which has now been established.

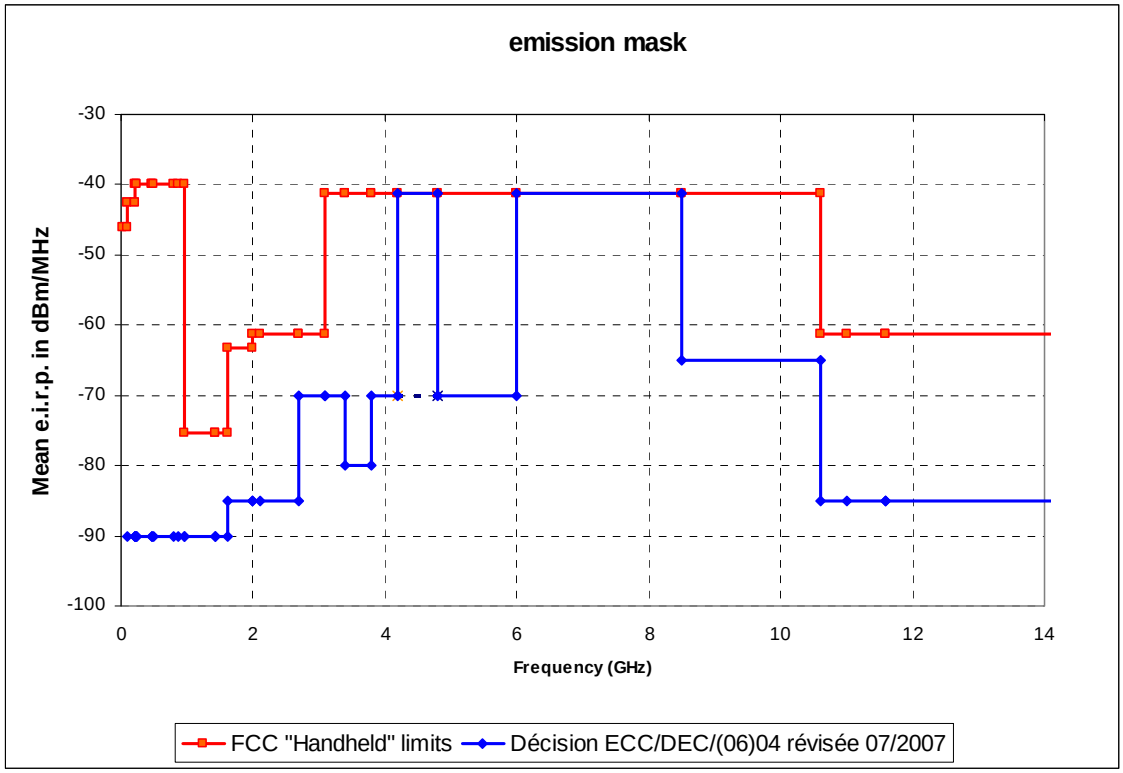


Figure 6-1: European spectrum mask compared to FCC regulation

Frequency band	Power spectral density (e.i.r.p.)
< 1.6 GHz	–90 dBm/MHz
1.6 - 2.7 GHz	-85 dBm/MHz
2.7 - 3.4 GHz	-70 dBm/MHz
3.4 - 3.8 GHz	-80 dBm/MHz
3.8 - 4.2 GHz	–70 dBm/MHz
4.2 - 4.8 GHz	*–70 dBm/MHz* *(–41.3 dBm/MHz)*
4.8 - 6 GHz	–70 dBm/MHz
6 - 8.5 GHz	–41,3 dBm/MHz
8.5 - 10.6 GHz	–65 dBm/MHz
> 10.6 GHz	–85 dBm/MHz

Table 6-1 : European PSD

6.2 Conclusion on specific UWB regulation

The signal radiated by Ground- and Wall- Probing Radar (GPR/WPR) imaging systems and Building Material Analysis (BMA) devices is intended to be transmitted into the material being investigated (ground, walls, building structures…). The reduction of the radiations into the air as a result of the operation of these systems, referred in this context as “undesired emissions”, is a specific design task for the manufacturers and may e.g. necessitate appropriate shielding of the device. This does not necessarily affect the performance of the application.

ECC has developed and approved specific UWB regulations for these applications recognizing the above specificity and the benefits offered by UWB technology in providing accuracy in imaging applications (i.e. Decisions ECC/DEC/(06)08 and ECC/DEC/(07)01).

(GPR/WPR) imaging systems and Building Material Analysis (BMA) devices differ however significantly in terms of expected densities, usage patterns, and possible licensing regime, which was considered as the key discriminating factor; as well as performance requirements.

The performance requirements of these applications have led to the identification of different frequency bands with different emission power values according to the needed resolution/accuracy.

Compatibility studies for GPR/WPR and BMA have differed significantly taking into account their various features. For instance, unlike for BMA, only single interference analyses have been considered

in case of GPR/WPR. The protection of some sensitive radio stations (radars, radio astronomy observatories) can be achieved for GPR/WPR through adequate coordination procedures as these systems are used in relative small numbers by trained professionals. Conversely, effective BMA operation is subject in some frequency bands to the implementation of adequate mitigation techniques.

Finally, CEPT recognizes the need to carefully monitor the impact of these imaging applications on radio services. Proposed regulations should be reviewed within three years of their adoption based on the experience gained.

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