Proposed Regulatory Arrangements for Ultra-Wideband Services in Australia

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***Abstract*— Spectrum regulators worldwide have introduced regulations to facilitate the introduction of ultra-wideband (UWB) technologies. The Australian Communications and Media Authority (ACMA) will soon be introducing similar arrangements to allow for the introduction of UWB devices into the Australian market. Following extensive industry consultation, the ACMA is finalising regulatory arrangements to support UWB devices operating in Australia in the frequency ranges 3.6-4.8 GHz and 6.0-8.5 GHz and is considering the need for further spectrum above 10 GHz for the likely expansion and development of UWB technologies. This paper details the adopted international regulatory arrangements and the proposed Australian regulatory arrangements to facilitate coexistence with existing services in the identified segments.**

Keywords- UWB; ultra-wideband, regulatroy arrangements

I. INTRODUCTION

The United States introduced regulatory arrangements supporting a broad range of applications using UWB technology in 2002. However, global support for the development of regulatory arrangements slowed as a result of concerns by incumbent operators in relevant frequency bands. These concerns were based on worst case technical studies indicating a potential threat to the interference margins of existing services from the operation of UWB devices.

Planning and regulatory arrangements have now been introduced in a number of countries; and the Radiocommunications Sector of the International Telecommunication Union (the ITU-R) also implemented Recommendations supporting the introduction and use of UWB technologies in 2006 [1].

The ubiquitous nature of low power UWB applications and the growing availability and demand for devices including UWB technology has increased pressure on the ACMA to develop internationally harmonised regulatory arrangements.

II. INTERNATIONAL DEVELOPMENTS

A. *United States of America*

The Federal Communications Commission (the FCC) is the regulator for all non-government radiocommunications services in the USA. The FCC released its First Report and Order (rule making) on UWB in February 2002 creating Sub-part F, of Part 15 of the FCC Rules and Regulations [2]. This new sub-part sets out the rules that permit the marketing and unlicensed operation of range of products based on UWB technology including indoor and handheld devices.

The UWB bandwidth for indoor and handheld devices must be contained between the frequencies 3.1 GHz and 10.6 GHz. Table 1 provides the broadband radiated emission limits.

In addition to the broadband radiated emission limits specified in Table I, a device must not exceed the average narrowband limits of Table II to protect Global Positioning System (GPS) systems.

TABLE I. UWB BROADBAND RADIATED EMISSION LIMITS ADOPTED BY USA

Frequency (MHz)	**Indoor**	**Outdoor**
	Mean Power Spectral Density (dBm/MHz)	***Mean Power Spectral Density (dBm/MHz)***
960 – 1610 MHz	-75.3	-75.3
1610 – 1990 MHz	-53.3	-63.3
1990 – 3100 MHz	-51.3	-61.3
Above 10,600 MHz	-51.3	-61.3

TABLE II. UWB EMISSION LIMITS FOR THE PROTECTION OF GPS RECEIVERS

Frequency (MHz)	***Mean Power Spectral Density (dBm/MHz)***
1164 – 1240 MHz	-85.3
1559 – 1610 MHz	-85.3

B. *European Conference of Postal and Telecommunications Administrations (CEPT)*

Within the European Conference of Postal and Telecommunications Administrations (CEPT, the Electronic Communications Committee (ECC) is responsible for radiocommunications and telecommunications matters.

The decision (ECC/DEC/(06)04)[3] of March 2006 provided for the ongoing use of UWB technology without the use of interference mitigation techniques in the band 6 – 8.5 GHz and in the band 4.2 - 4.8 GHz on a temporary basis until 2010

A further decision ECC/DEC/(06)12[4] defined harmonised requirements for UWB devices using Low Duty Cycle (LDC) as a mitigation technique in the frequency band 3.4 - 4.8 GHz exempting them from individual licensing.

In February 2007, the European Commission decided in favour of allowing UWB technologies to operate in accordance with harmonised arrangements based on decisions of the ECC [5].

Table III provides the broadband radiated emission limits adopted by CEPT.

TABLE III. UWB BROADBAND RADIATED EMISSION LIMITS ADOPTED BY CEPT

Frequency (GHz)	***Mean Power Spectral Density (dBm/MHz)***	***Peak Power Spectral Density (dBm/ 50 MHz)***
Below 1.6 GHz	-90.0	-50.0
1.6 to 2.7 GHz	-85.0	-45.0
2.7 to 3.4 GHz	-70.0	-45.0
3.4 to 3.8 GHz	-80.0	-30.0
3.8 to 4.2 GHz	-70.0	-30.0
4.2 to 4.8 GHz	-70.0 (Notes 1 & 2)	-30.0 (Note 1)
4.8 to 6.0 GHz	-70.0	-30.0
6.0 to 8.5 GHz	-41.3 (Note 2)	0.0
8.5 to 10.6 GHz	-65.0	-25.0
Above 10.6 GHz	-85.0	-45.0

Note 1: Before 31 December 2010, a mean EIRP -41.3 dBm/MHz and a peak EIRP of 0 dBm/50 MHz

Note 2: Road or rail vehicle limit -53.3 dBm/MHz or have Transmitter Power Control (TPC).

C. *United Kingdom*

Ofcom is responsible for authorising civilian use of the radiofrequency spectrum in the United Kingdom.

In July 2007, Ofcom adopted its regulation exempting compliant UWB equipment from obtaining a licence [6]. The regulation effectively includes the European Commission Decision into UK legislation by incorporating it by reference, rather than seeking views on the content of the Decision itself. Table IV summarises the emission levels specified in the regulation.

TABLE IV. UWB EMISSION LIMITS ADOPTED BY OFCOM

Frequency (GHz)	***Mean Power Spectral Density (dBm/MHz)***	***Peak Power Spectral Density (dBm/ 50 MHz)***
Below 1.6 GHz	-90.0	-50.0
1.6 to 3.4 GHz	-85.0	-45.0
3.4 to 3.8 GHz	-85.0	-45.0
3.8 to 4.2 GHz	-70.0	-30.0
4.2 to 4.8 GHz	-41.3	0.0
4.8 to 6.0 GHz	-70.0	-30.0
6.0 to 8.5 GHz	-41.3	0.0
8.5 to 10.6 GHz	-65.0	-25.0
Above 10.6 GHz	-85.0	-45.0

D. *Canada*

In May 2009, Industry Canada adopted its radio equipment certification standard [7] for devices using UWB technology. The standard sets out limits for indoor devices of -41.3 dBm/MHz across the 4.75 - 10.6 GHz band. Emissions outside this band are limited to a maximum radiated mean power spectral density as summarized in Table V.

TABLE V. UWB EMMISSION LIMITS ADPOTED BY CANADA

Frequency (GHz)	***Mean Power Spectral Density (dBm/MHz)***	***Peak Power Spectral Density (dBm/ 50 MHz)***
0.96 - 1.6 GHz	-75.3	-50.0
1.6 to 4.75 GHz	-70	-45.0
4.75 to 10.6 GHz	-41.3	-45.0
Above 10.6 GHz	-51.3	-45.0

E. *New Zealand*

In September 2008, The Radio Spectrum Management Policy and Planning Resources and Networks branch of the Ministry of Economic Development (the MED), made a decision to adopt the post 2010 European arrangements in a General User radio Licence (GUL) for UWB devices [8] in the frequency range. The European arrangements adopted reflect ECC/DEC(06)04 as amended that appear in the ETSI Standard EN 302 065. The adoption of the post 2010 arrangements avoids the need to apply the transitional arrangements that currently apply in that framework.

F. *Japan*

The Ministry of Public Management, Home Affairs, Post and Telecommunications has introduced arrangements supporting the use of UWB technology [9]. Current regulations allow the unlicensed operation of indoor UWB devices in the frequency bands 3.4 - 4.8 GHz and 7.25 - 10.25 GHz at a maximum radiated mean power spectral density of than -41.3 dBm/MHz. In the frequency band 3.4-4.8 GHz, equipment must use detect and avoid (DAA) protocols else the limit for emissions in the band becomes -70 dBm/MHz.

G. *Summary of international arrangmentsfor indoor UWB devices*

All indoor UWB devices are limited to operate with an average power of -41.3 dBm/MHz and a peak power of 0 dBm/50 MHz peak. Some countries have placed additional limitation on the operation of use, as summarised in Table VI.

TABLE VI. INTERNATIONAL ARRANGEMENTS FOR UWB DEVICE AUTHORISATION

Frequency band	In-band limitations	Agency / Organisation
3.1 – 10.6 GHz	No additional limitations	FCC (USA)
4.75 – 10.6 GHz	No additional limitations	Canada
3.4 – 4.8 GHz	Low duty cycle	CEPT (Europe)
4.2 – 4.8 GHz	Until 31 December 2010 without mitigation devices	
6.0 – 8.5 GHz	No additional limitations	
3.4 – 4.8 GHz	Low duty cycle	Ofcom (UK)
4.2 – 4.8 GHz	No additional limitations	
6.0 – 8.5 GHz	No additional limitations	
3.4 – 4.8 GHz	Devices must use mitigation techniques Mitigation is not required in the sub-band 4.2-4.8 GHz until 2011	Singapore
6.0 – 9.0 GHz	No additional limitations	
3.4 – 4.8 GHz	DAA required, but in 4.2-4.8 GHz only from December 2008	Japan
7.25 – 10.25 GHz	No additional limitations	
3.1 – 4.8 GHz	DAA required, but in 4.2-4.8 GHz only from July 2010	Korea
7.2 – 10.2 GHz	No additional limitations	

III.

IV. PROPOSED AUSTRALIAN ARRANGEMENTS

Australia is largely an importer or adopter of technologies, thus harmonisation of spectrum arrangements would ensure that devices manufactured overseas are also able to be used in Australia. International harmonisation also enables users to experience the benefits associated with the development of economies of scale that develop in larger markets.

An examination of overseas regulatory arrangements, manufacturing developments and general product characteristics indicates that UWB devices intended for ubiquitous, indoor operation are being developed for operation in a number of frequency bands among which there is a common support for the frequency bands 3.1 - 4.8 GHz and 6.0 - 8.5 GHz.

In Australia, the frequency band 3.4 – 3.575 GHz is designated for spectrum licensing. Therefore, the ACMA intends to align its frequency allocations with other international bodies and develop regulatory and licensing arrangements that would include spectrum in the 3.6 - 4.8 GHz and 6.0 - 8.5 GHz bands for UWB technologies. In the 3.6 - 4.8 GHz band, the ACMA will require UWB devices to employ additional mitigation techniques, such as DAA.

The ACMA will align itself with overseas arrangements and adopt in-band spectral power density limits for UWB devices of -41.3 dBm/MHz EIRP and a peak power limit of 0 dBm /50 MHz EIRP.

The ACMA intends to adopt an out-of-band spectral density limit of -70 dBm per MHz in the segments 2.7 - 3.6 GHz and 4.8 – 6.0 GHz in line with other ITU-R Region 3 countries. These limits would allow devices manufactured for European, Japanese, Korean and US markets to meet requirements and subsequently be available for use in Australia. Thus, allowing early adoption of UWB technology while providing significantly more protection than is currently provided between existing radiocommunications services.

Below 2.7 GHz and above 8.5 GHz, the ACMA intends to adopt the out-of-band spectral density mask set by European arrangements for indoor UWB devices.

Fig. 1 illustrates the intended ACMA emission limits for UWB.

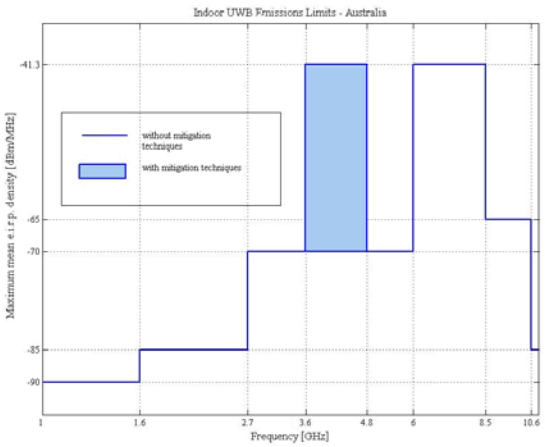

Figure 1. Proposed ACMA emission limits for UWB

V. FUTURE AUSTRALIAN CONSIDERATIONS

This discussion paper primarily focused on the development of arrangements to support UWB in the frequency

bands 3.6 - 4.8 GHz and 6.0 - 8.5 GHz. The ACMA has noted that UWB devices are being manufactured that also use other frequency bands. Therefore, it is likely that in the future the ACMA will need to consider either supporting use of these other bands by UWB devices or applying compliance enforcement measures. The growth of technologies like UWB and their use in consumer devices will probably mean that UWB devices will be imported as embedded features in a wide variety of consumer products. It is likely that consumers or users would be unaware of the existence of such devices and would operate regardless of Australian regulatory requirements.

The frequency ranges of most interest, as indicated by industry to the ACMA, are 22.5 – 26.5 GHz and 70 – 80 GHz. The ACMA is maintaining a watching brief on the developments of these bands for future UWB considerations.

The ACMA has recently enacted amendments to the legislation governing the use of the radiofrequency spectrum that enable the deployment of class licensed devices in spectrum licensed space. Prior to this change, class licensing could only apply to bands designated for apparatus licensing. While these arrangements may not be feasible for all spectrum licensed bands, it may provide an alternative approach in some cases for aligning Australian UWB arrangements with international arrangements as they continue to evolve.

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