Ministry of Economic Development
Manatū Ōhanga

Spectrum Allocations for Ultra Wide Band Communication Devices

A Discussion Paper

April 2008

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Introduction

Ultra Wide Band (UWB) is a radio technology developed to transmit information at low levels of power spectral density, near the noise floors of radio receivers and spanning bandwidths in the order of Gigahertz. This characteristic makes the short range transmission of information at very high data rates possible. Theoretically, communication devices using UWB techniques can share spectrum with other licensed services without producing harmful interference to those services.

New Zealand has already implemented a regulatory framework for UWB technology; UWB radar under a GUL and imaging applications under radio licensing. These licensing arrangements have been in place since 2005 without reports of any interference issues. Licensing of UWB communications applications however have not been finalised in New Zealand, pending international developments. That is, interim licences have been issued by the Ministry only on a case by case basis for the trialling of UWB communication devices.

The International Telecommunications Union (ITU) released in 2006 a series of recommendations on UWB, identifying unlicensed approaches as best suited for UWB communications. Between 2002 and 2007, several administrations have adopted unlicensed frameworks for the adoption of UWB communications including the USA, Europe and various Asia Pacific nations. These frameworks include the requirement to conform with specific spectral masks and operational conditions in order to protect existing radiocommunication services. These recent international developments on UWB regulation require New Zealand to review its current licensing approach on UWB communication applications.

The Ministry encourages economic growth through technological innovation, and therefore wishes to consult with industry on appropriate regulatory frameworks for UWB communications in New Zealand.

The aim of this discussion paper is to find an appropriate licensing arrangement for UWB communications in New Zealand. The paper considers recent developments in the regulation of UWB communications and related technical standards adopted by our trading partners internationally. It solicits the opinions of UWB vendors, potential operators, existing spectrum users and other stakeholders on appropriate technical standards and a number of related issues.

Invitation for Submissions

Comments on the questions contained in this paper and on any related issues, are invited from interested parties. Written submissions should be sent no later than **[15 May 2008]** to:

Spectrum Allocation for UWB Communication Devices
Radio Spectrum Policy and Planning
Ministry of Economic Development
PO Box 1473
WELLINGTON

or emailed to:

radiospectrum@med.govt.nz (preferred option)

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Glossary

ACMA	Australian Communications and Media Authority
APT	Asia Pacific Telecommunity
CEPT	Conference of European Posts & Telegraphs
EC	European Commission
ECC	Electronic Communications Committee
e.i.r.p	equivalent isotropically radiated power
ETSI	European Telecommunications Standards Institute
FCC	Federal Communications Commission (USA)
GUL	General User Licence
GURL	General User Radio Licence
IDA	Infocomm Development Authority (Singapore)
IEEE	Institute of Electrical and Electronic Engineers (USA)
IEEE 802.15xx	IEEE standards for PAN devices and systems
ITU-R	International Telecommunications Union – Radiocommunications Sector
MAC	Media Access Control layer
NTIA	National Telecommunication Information Administration (USA)
Ofcomm	Office of Communications (UK)
OFDM	Orthogonal Frequency Division Multiplex
PAN	Personal Area Network
PHY	Physical layer
RF	Radio Frequency
SG	ITU-R Study Group
SRD	Short Range Device
TG	ITU-R Task Group
UFZ	UWB Friendly Zone

UWB	Ultra Wide Band
WG	ITU-R Working Group
WLAN	Wireless Local Area Network

1. Background

Planning the allocation of the radio spectrum and ensuring that it is optimally utilised is a responsibility of the Ministry of Economic Development (the Ministry). Ultra wide band (UWB) is an emerging technology that offers a new paradigm for the allocation and use of the radio spectrum. It is necessary to find a balance between encouraging technologies such as UWB communications and protecting existing radiocommunication services from harmful interference. Inaction is likely to have an economic cost by preventing New Zealand companies from taking advantage of new and innovative technologies. Examples of UWB communications include Personal Area Networks (PAN), Wireless Local Area Networks (WLAN); home entertainment, multimedia interfaces, wireless USB devices and high precision location RFID.

In April 2005, The Ministry published the document "*Engineering Discussion Paper on Spectrum Allocation for Ultra Wide Band Devices*[1]" to discuss possible spectrum allocation options for UWB technology. During the same year, The Ministry analysed a number of licence applications for UWB communications. Some field trials were also performed using mobile low data rate UWB devices outdoors, with no interference issues found.

Having considered the submissions on the 2005 discussion paper, the Ministry granted a GUL arrangement for UWB radar and a radio licensing regime for imaging applications. There have been no incidents of interference complaints so far and the Ministry is not proposing to make any changes to the current licensing arrangement for radar and imaging applications. Bearing in mind the early stages of commercial UWB communication applications at the time, the Ministry adopted the approach of granting interim radio licences for UWB communication trials. This arrangement was put in place to allow trials on a case-by-case basis enabling New Zealand companies to research the potential of this technology while monitoring international trends.

Since 2006, UWB product development has been gaining momentum internationally. UWB communications have emerged onto the market covering applications such as RFID and wireless USB. In addition to these trends, semiconductor makers are including UWB communication technology in their chipsets for a variety of applications ranging from multimedia applications, consumer electronics and mobile communications.

The International Telecommunications Union (ITU) released in 2006 a series of recommendations on UWB, identifying licence exempt approaches as best suited for short range indoor and outdoor UWB communications. Between 2002 and 2007, several administrations have adopted unlicensed frameworks for the adoption of UWB communications including the USA, Europe and various Asia Pacific nations. These frameworks include the requirement to conform with specific spectral masks and operational conditions in order to protect existing radiocommunication services. Europe in particular has released a number of technical standards specifying the compatibility

[1] This document can be referred to: http://www.rsm.govt.nz/cms/policy-and-planning/current-projects/radiocommunications/spectrum-allocations-for-ultra-wide-band-technology/an-engineering-discussion-paper-on-spectrum-allocations-for-ultra-wide-band-devices

and performance requirements for communication devices employing UWB technology. These international developments mean that it is necessary for New Zealand to review its current licensing approach on UWB communication applications.

This paper therefore focuses solely on UWB communication applications. The objective is to develop an appropriate licensing arrangement for UWB communication devices in New Zealand.

2. Developments in Regulatory Frameworks for UWB Communication Devices

A primary consideration in the development of regulatory frameworks and standards for the introduction of UWB communication systems has been the protection of incumbent radiocommunication services against harmful interference.

The ubiquitous nature and low power of existing and foreseen UWB communication devices makes an unlicensed regime (general user licensing regime in NZ) most suitable for such applications. Overseas administrations have adopted a general user licensing approach with licence conditions that include emission limits, restrictions on outdoor deployment and spectrum emission masks.

In 2002, the FCC released the first regulatory resolution allowing UWB transmissions under an unlicensed regime. This resolution requires communications systems to comply with the limits of a spectral mask in the 3.1-10.6 GHz band (Figures 1 and 2).

The European Community released in 2007, their proposed general user mask for UWB communications between 3.1 and 10.6 GHz (Figure 3), based on extensive studies performed by CEPT and ETSI. The International Telecommunications Union (ITU) also released a series of recommendations on UWB; favouring a general user licensing approach that includes provisions for the protection of existing services. These provisions include emission masks, interference mitigation techniques and product certification.

Global consensus exists on the non-interference, non- protection nature of UWB regulation, since ubiquitous communication devices employing UWB technology will be sharing spectrum with other services already in place. The maximum spectral power limit of -41.3 dBm/ MHz has been identified as appropriate by all current overseas regulatory resolutions.

In terms of New Zealand frameworks, Part 13 of the Radiocommunications Act[2] and Part 9 of the Radio Regulations[3] include provisions for interference protection of radiocommunications services and policy for the granting of general user radio licences in New Zealand. These regulations and EMC Standards[4] provide the technical compatibility framework. Along with the development of joint AS/NZS standards[5], international standards are adopted in New Zealand where possible.

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[2] The NZ Radiocommunications Act can be referred to: http://www.legislation.govt.nz/act/public/1989/0148/latest/DLM197332.html

[3] The NZ Radio Regulations can be referred to: http://www.legislation.govt.nz/regulation/public/2001/0240/latest/DLM71539.html

[4] NZ Radio standards and EMC standards can be referred to: http://www.rsm.govt.nz/cms/product-compliance/suppliers/standards-and-compliance-requirements

[5] AS/NZS standards can be referred to: http://www.standards.co.nz/default.htm

2.1 International & Regional Regulatory Frameworks

2.1.1 International Telecommunications Union (ITU)

The ITU provides guidance to administrations on the introduction of UWB communication devices through a number of recommendations[6].

Following the outcome of a number of study initiatives carried by ITU-R (TG1/8), it has been concluded by the ITU that the introduction of UWB devices is subject to operation on a non- interference and non-protection basis and has published the following recommendations:

- SM.1754: *Measurements techniques of ultra-wideband transmissions*. This document provides guidance on the measurement of UWB signals in the frequency domain and in the time domain.

- SM.1755: *Characteristics of ultra-wideband technology.* This recommendation provides the terms and definitions employed in UWB technology. It also provides information on technical and operational characteristics of UWB.

- SM.1756: *Framework for the introduction of devices using ultra-wideband technology.* This framework provides guidance to administrations when considering the introduction of devices employing UWB. It considers the issues to take into account in order to protect all radiocommunication services from interference. This document also recommends deployment of short range UWB communications under a general licence regime and provides information on emission masks adopted by relevant administrations.

- SM.1757: *Impact of devices using ultra-wideband technology on systems operating within radiocommunications services.* This recommendation provides a compilation of studies and results that may be considered in order to assess the impact of UWB devices on existing radiocommunications. It describes deterministic and statistical methodologies used in interference analysis.

While the ITU, through its Recommendation SM.1756, identifies a general user licensing regime as best suited for regulating short range UWB communications, it does not recommend a particular spectral mask. The ITU recognises the sovereign rights of administrations for regulating UWB communication devices within their territorial boundaries and recommends the adoption of rigorous product certification provisions.

[6] ITU recommendations are available at: http://www.itu.int/rec/R-REC-SM/e

2.1.2 APT

The Asia Pacific Telecommunity Wireless Forum (APT/ AWF) released a report (APT/AWF/REP-1[7]) in August 2007, which provides details of UWB regulatory developments in the Asia Pacific region and abroad. The document states the positions of Japan and Korea on UWB, where unlicensed use has been allowed but with different spectrum masks to those adopted in Europe and the USA. These spectrum masks are "notched" to allow protection in particular bands between 3.1 and 10.6 GHz. Other administrations such as Singapore and Hong Kong have allowed UWB trials in specific locations and have adopted similar masks to those implemented by Europe. The report also describes the regulatory developments in other relevant administrations around the world such as the USA and Europe. The APT report recommends the adoption of harmonised regulatory provisions to protect existing radiocommunication services under the following guidelines:

- To allow deployment of UWB devices in parts of the bands below 10.6 GHz while ensuring protection of existing and planned radiocommunication services,
- To adopt licence-exempt or class licensing approach for operating UWB devices,
- To cap the maximum power spectral density at -41.3 dBm/MHz for licence-exempt or class licence devices - whilst incorporating notching requirements to ensure protection of existing and planned stations in the allocated bands; and
- To consider implementing other mitigation techniques to protect the existing radiocommunication services.

2.1.3 Europe: CEPT, ETSI & IEC

In March 2004 (and later again in 2005), the European Commission (EC) mandated the Conference of European Posts & Telegraphs (CEPT) to develop technical implementation measures for the harmonised use of radio spectrum for UWB within the European Union. The outcome of the studies undertaken by CEPT resulted in the EC adopting a licence exempt regime for UWB, on a non-interference, non- protected basis. The EC defined spectral and power limits for UWB technology below 10.6 GHz and excluded the deployment of UWB communication devices in fixed outdoor locations, automotive vehicles, railway vehicles and aircraft. This decision came into force in July 2007.

The EC approach is somewhat different to the US regulatory approach, since it mandates more stringent power limits in the spectral mask (Figure 3). These limits reflect the findings of the CEPT studies in Report 64 delivered to ECC in 2005[8], which

[7] APT/ AWF report can be referred to: http://www.aptsec.org/Program/AWF/Approved%20Recommendations/(AWF%20Rep1)Report_on_UWB.pdf

[8] CEPT resolutions can be referred to: http://www.erodocdb.dk/doks/relation.aspx?docid=2188

identified that the majority of the radio services below 10.6 GHz required more protection than that afforded by the FCC mask. The EC decision also places special consideration on coexistence issues for the protection of specific bands: for example the 3.4-3.8 GHz band. Section 18 of the European Commission decision 2007/131 specifies "that UWB technology without appropriate mitigation techniques should be time limited and be replaced by more restrictive conditions beyond the date 31 December 2010, because there is an expectation that equipment of this type should operate exclusively above 6 GHz in the longer term".

The final decision on UWB regulation in Europe was published in February 2007. This decision specifies the final emission limits for UWB communications, makes provisions for the utilisation of mitigation techniques including low duty cycle considerations and other operational conditions.

The following relevant publications describe the framework adopted by EC:

- ECC Report 64, 2005 and Annexes: The protection requirements of radiocommunications systems below 10.6 GHz from generic UWB applications. This report included the analysis of the following aspects:

  - *Complementary technical studies focused on three selected coexistence scenarios (Fixed Satellite Services, outdoor Fixed Services and indoor FWA scenarios);*
  - *an impact analysis, structured per frequency range, initially considering a mean e.i.r.p. spectral density limit of -55 dBm/MHz in the 3.1-10.6 GHz frequency range, taking into account possible mitigation factors in particular restriction to indoor UWB applications.*

- ECC Decision of 1 December 2006: ECC/DEC/ (06)12. The harmonised conditions for devices using UWB technology with low duty cycle in the frequency band 3.4-4.8 GHz.

- ECC Decision 2006 amendment: Amended ECC/DEC/ (06)04. ECC Decision of 24 March 2006 (amended 6 July 2007) on the harmonised conditions for devices using UWB technology below 10.6 GHz. This document included the following areas:

  - *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.*

- 2007/131/EC, Commission Decision of 21 February 2007 on allowing the use of the radio spectrum for equipment using UWB technology in a harmonised manner in the European Community.

The European Telecommunications Standards Institute (ETSI) participates in CEPT regulatory activities for harmonising radiocommunications in Europe. In 2001, ETSI published and submitted to ITU the System Reference Document TR 101 994-1 for UWB communications purposes[9]. Later in 2008, it released the harmonized standard EN 302 065 in response to a mandate from EC in 2003, to investigate and develop radio standards for short range UWB devices. This standard applies to fixed (indoor only), mobile and portable transceivers utilizing UWB for short range communication applications. Under the EC framework, UWB systems in fixed outdoor locations and aircraft are not covered.

EN 302 065 provides generic technical guidelines for different types of short range UWB devices including electromagnetic compatibility, measurement and technical specifications. It divides these applications into impulse radio and carrier based radio technologies. The spectrum limits applicable to these technologies are the proposed masks set out in the ECC decision report 64 (Figure 3).

ETSI has published the following UWB standards (communications):

- TR 101 994-1 Short Range Devices (SRD); Technical characteristics for SRD equipment using UWB technology. Part 1: Communications applications (2004).
- EN 302 065 Ver.1.1.1 Electromagnetic compatibility and Radio spectrum Matters (ERM); Ultra Wideband technologies for communications purposes; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive (2008).
- EN 302 065 Ver.1.2.1 Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD) using Ultra Wideband technologies for communications purposes; Harmonized EN covering the essential requirements of article 3.2 of the R&TTE Directive (Draft).
- EN 302 500-1 Ver.1.2.1 Electromagnetic compatibility and Radio spectrum Matters (ERM); Short Range Devices (SRD) using Ultra Wideband technology; Location and Tracking equipment operating in the frequency range form 6 GHz to 8.5 GHz; Part 1: Technical characteristics and test methods (2007)
- TS 102 455 Ver.1.1.1 High rate Ultra Wideband PHY and MAC standard (Ecma-368/December 2005, modified)

The International Electrotechnical Commission (IEC) approved in 2007 two ISO/IEC international standard specifications for high data rate UWB[10]. These were based on specifications released by Ecma International in 2005 (ECMA 368 and ECMA 369). These standards relate to UWB technology employing MB-OFDM (Multi Band – Orthogonal Frequency Division Multiplex)

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[9] ETSI standards are available at: http://www.etsi.org/WebSite/Standards/Standard.aspx

[10] IEC standards can be referred to: http://www.iec.ch/searchpub/cur_fut.htm

The following ISO/IEC standards for UWB communications have been developed:

- ISO/IEC 26907:2007. Information technology - Telecommunications and information exchange between systems - High rate UWB PHY and MAC standard.

- ISO/IEC 26908:2007. Information technology - MAC – PHY interface for ISO/IEC 26907.

2.2 Country Specific Regulatory Frameworks

2.2.1 United States of America: FCC & IEEE

The United States of America was the first country to develop and release a regulatory framework for the open use of UWB technology. Numerous compatibility studies were carried out by the National Telecommunications and Information Agency (NTIA) and the Federal Communications Commission (FCC) to assess the impact of UWB emissions sharing spectrum with other services. NTIA released in 2001 an extensive report (01-43) “Assessment of compatibility between UWB devices and selected federal systems”, which provides details of the studies and practical tests that have been conducted and makes recommendations on UWB coexistence with other radio systems. The report covers compatibility assessments with aviation safety radio systems, maritime radionavigation, fixed satellite service and meteorological radar. The maximum permissible EIRP spectral density of -41.3 dBm/ MHz (RMS) is recommended in the report for frequencies above 1 GHz. Reports 01-384 and 01-45, were also released in 2001 by NTIA to cover compatibility of UWB with GPS receivers. The NTIA tests and analysis were based on UWB systems operating with pulsed emissions.

The FCC issued its First Report and Order in February 2002, in which it amended its Part 15 rules on unlicensed radio devices to allow the operation of UWB devices. Subpart F was created specifically to cover UWB devices[11]. FCC Subpart F defines UWB transmitters in the following way: “An intentional radiator that, at any point in time, has a fractional bandwidth equal to or greater than 0.20 or has a UWB bandwidth equal to or greater than 500 MHz, regardless of the fractional bandwidth”. Under subpart F, there is a broad range of requirements for the registration of UWB devices. The FCC has made spectrum available between 3.1GHz to 10.6 GHz for unlicensed UWB communications devices (indoor or handheld) with a maximum power emission limit of -41.3 dBm/MHz. The FCC spectrum mask for UWB communications devices specifies the allowed limits for UWB operation. The FCC proposes that this limit will ensure the appropriate unlicensed operation of UWB devices without causing interference to existing licensed users of the 3.1-10.6 GHz frequency band. To provide additional protection to GPS users, the FCC has also mandated that spurious emissions between 1 GHz and 2 GHz be limited to -75 dBm/MHz.

[11] FCC Part 15 Subpart F can be referred to: http://www.fcc.gov/oet/info/rules/part15/part15-9-20-07.pdf

FCC has published the following documents regarding UWB communication devices under Part 15 and Subpart F:

- 15.501 Scope
- 15.503 Definitions
- 15.505 Cross reference
- 15.507 Marketing of UWB equipment
- 15.517 Technical requirement for indoor UWB devices
- 15.519 Technical requirements for handheld UWB systems
- 15.521 Technical requirements applicable to all UWB devices
- 15.250 Operation of wideband systems within the band 5.925-7.250 GHz

Additional restrictions placed on indoor UWB communication systems:

- They can be used solely for indoor operations.
- Emissions shall not be intentionally directed outside of the building in which the device is located.
- The use of outdoor mounted antennas is prohibited.
- The intentional radiator can only transmit when it is sending information to an associated receiver.

Additional restrictions placed on handheld outdoor UWB communication systems:

- They must be relatively small hand-held devices and should not employ a fixed infrastructure.
- They can only transmit when the intentional radiator is sending information to an associated receiver. The UWB radiator should cease transmission within 10 seconds unless it receives an acknowledgment from the associated receiver that its transmission is being received. These acknowledgments of reception must continue to be received by the UWB radiator at least every 10 seconds or the device must cease transmitting.

The global industry standards developer, IEEE-SA (Institute of Electrical and Electronic Engineers – Standards Association) formed two task groups in 2003 under its 802.15 WPAN[12] framework:

Task Group 4: Low Rate WPAN

Within this group, 802.15.4 dealt with low data rate, low complexity applications. 802.15.4a (WPAN Low Rate Alternative PHY) was then formed to cover applications involving low data rate communications and high precision location systems. The outcome of this later group was the definition of two optional PHY specifications: Chirp Spread Spectrum (operating under 2.4 GHz unlicensed band) and UWB Pulse Radio (operating under unlicensed UWB bands). The specifications covered by 802.15.4a were officially approved by IEEE-SA in 2007.

Task Group 3: High Rate WPAN

TG3 was subdivided into two working groups: 802.15.3 responsible for developing a standard for the MAC and PHY layers of high data rate WPANs; and 802.15.3a (High Rate WPAN Alternative PHY) to provide an enhancement to 802.15.3 to cover higher rate UWB PHY applications. 802.15.3a achieved the consolidation of a number of PHY specifications. In 2006 however, this group was disbanded due to disagreements amongst its parties.

The main reason for this disbandment was the existence of two different industry tendencies. These two industry groups were representing distinct UWB technologies, and therefore had disagreement on the adoption of a physical layer for high data rate UWB communications systems. One group was supporting the adoption of Direct Sequence – UWB and the other was supporting Multi-Band OFDM. This problem arose as a consequence of the spectral mask for UWB communications being specified but no specification being made on how the UWB bandwidth is achieved. As a result, the development of a standard for high data rate UWB was left incomplete.

2.2.2 United Kingdom: OFCOM

The UK spectrum regulator, Office of Communications (Ofcom), released in August 2007 an exemption for the unlicensed deployment of UWB (Statutory Instrument No.2084[13]). This regulation is harmonised with Europe's EC decision 2007/131.

Section 2 of the Ofcom resolution defines UWB communications equipment in the following way as per EC decision: "ultra-wideband equipment means a wireless telegraphy station or wireless telegraphy apparatus incorporating, as integral part or as an accessory, technology for short-range radiocommunication involving the intentional generation and transmission of radio-frequency energy that spreads over a frequency range wider than 50 MHz, which may overlap several frequency bands allocated to wireless telegraphy".

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[12] IEEE standards can be referred to: http://www.ieee802.org/15/pub/TG4a.html

[13] Ofcom resolution No. 2084 can be referred to: http://www.opsi.gov.uk/si/si2007/pdf/uksi_20072084_en.pdf

The Ofcom resolution also provides spectrum limits for UWB communications in accordance with the European Commission. Section 4 describes the following provisions and limitations:

The equipment is used:

1. *indoors; or*

2. *other than indoors, provided it is not attached to:*

   - a fixed installation;
   - a fixed infrastructure;
   - a fixed outdoor antenna; or
   - an automotive vehicle or railway vehicle.

3. *The equipment does not cause or contribute to undue interference to any wireless telegraphy.*

The emissions limits specified by Ofcom are in accordance with the harmonised EC spectral mask in Figure 3.

2.2.3 Germany: FNA

The German administration in charge of spectrum regulation FNA, published its resolution on UWB communications in early 2008[14]. This resolution conforms to the European mandate and it also specifies the use of a 10 second rule control scheme for UWB communication transmitters.

2.2.4 Australia: ACMA

Australia has, so far, adopted a cautious approach. Since publishing a "Background Brief" on UWB in May 2003[15], the Australian Communications and Media Authority (ACMA), the spectrum regulator of Australia, has issued a few interim apparatus licences (authorised under a temporary "scientific assigned" licence). The view of the ACMA at this stage is that only applications with low potential to cause interference will be authorised under these interim licensing arrangements.

2.2.5 Canada: Industry Canada

In February 2005, Canada published a Consultation Paper[16] on the introduction of UWB wireless systems, seeking public interest and comment on UWB technology. Canada received public comments on the paper[17], which they expect to provide important input

[14] Germany's resolution can be referred to: http://www.bundesnetzagentur.de/media/archive/12424.pdf

[15] Australia's policy can be referred to: http://www.acma.gov.au/WEB/STANDARD/pc=PC_2645

[16] Industry Canada consultation paper can be referred to: http://strategis.ic.gc.ca/epic/site/smt-gst.nsf/vwapj/smse002consultation-e.pdf/$FILE/smse002consultation-e.pdf

[17] Submissions to the consultation paper can be referred to: http://www.ic.gc.ca/epic/site/smt-gst.nsf/en/sf05360e.html

for the development of specific spectrum policy and radio equipment standards for the introduction and use of UWB systems in Canada.

The view of Industry Canada is that a licence exempt approach along with compliance standards and product certification is a valid option to allow UWB communications devices.

2.2.6 Japan

In Japan, the Ministry of Public Management, Home Affairs, Post and Telecommunications, the Japanese spectrum regulator, proposed in 2005 its spectral mask for UWB communications[18]. This mask includes particular requirements for products operating in the bands 3.4-4.8 GHz. It specifies the implementation of Detection and Avoidance (DAA) technique to ensure coexistence with existing services. The limit of -41.3dBm/MHz has been imposed for unlicensed UWB communications devices operating between 3.4-4.8 GHz and between 7.25-10.25 GHz for indoor applications (Figure 6).

2.2.7 Korea

Similarly to Japan, Korea has adopted a modified FCC mask. The Korean resolution also specifies DAA requirements with the following time lines:

- from 2007, for devices operating between 3.1-4.2 GHz
- from 2010, for devices operating between 4.2-4.8 GHz

Source: APT/AWF report

2.2.8 Singapore: IDA

Infocomm Development Authority (IDA), the spectrum regulator of Singapore, launched its UWB programme in February 2003. Trials were set up by the IDA to permit controlled UWB emissions within a specific area in Singapore (named as the UWB Friendly Zone or UFZ) as part of the effort to introduce UWB. In 2007, IDA released an emission mask and technical specifications for UWB devices[19]. This resolution specifies rules similar to those established by Europe.

[18] Japan's policy can be referred to: http://www.rft.jp/UltraWidebandWirelessSystem.html

[19] IDA – Singapore policy can be referred to: http://www.ida.gov.sg/doc/Policies%20and%20Regulation/Policies_and_Regulation_Level2/IDATSUWB.pdf

2.2.9 Outline of Current Regulatory Implementations

The following table provides a summary of the regulatory approaches taken by regions and administrations specified in sections 2.1 and 2.2

Administration	Licence Regime	Max. e.i.r.p	Frequency bands/mask	Mitigation techniques	Operational conditions
Europe	Unlicensed	-41.3 dBm/ MHz	3.1 to 10.6 GHz with mask (Fig.3)	• Low duty cycle restrictions in the 3.4-4.8 GHz. • Expects products without mitigation techniques to operate exclusively above 6 GHz in the longer term.	• Indoor only. If outdoor, not attached to a fixed location. • Transmit Power Control for devices installed in road and rail vehicles in the 4.2-4.8 GHz and 6-8.5 GHz. • Time limited deployment for devices operating in the 4.2-4.8 GHz. • Resolution not applicable to aircrafts and other aviation.
US	Unlicensed	-41.3 dBm/ MHz	3.1 to 10.6 GHz with mask (Fig.1-2)	• Not specified	• Indoor only. • If outdoor, not attached to a fixed antenna. • Only transmit when sending information to associated receiver. • Handheld outdoor devices do not employ a fixed structure. • 10 second handshake rule only for handheld devices. • Prohibited operation onboard ships, aircraft or satellite.
UK	Unlicensed	-41.3 dBm/ MHz	3.1 to 10.6 GHz Harmonised EU mask (Fig.3)	• Low duty cycle restrictions in the 3.4-4.8 GHz.	• As per European harmonised mandate.
Germany	Unlicensed	-41.3 dBm/ MHz	3.1 to 10.6 GHz (harmonised EU mask)	• As per European harmonised mandate.	• As per European harmonised mandate. • 10 second rule handshake requirement for UWB communications.
Australia	Interim scientific	Non specific	Non specific	Not developed	Not developed

Administration	Licence Regime	Max. e.i.r.p	Frequency bands/mask	Mitigation techniques	Operational conditions
	licences				
Canada	Not developed	Non specific	Non specific	Not developed	Not developed
Japan	Unlicensed	-41.3 dBm/ MHz	3.4 to 10.25 GHz with mask (Fig.6)	• Mitigation techniques applicable between 3.4-4.8 GHz (DAA)	• Indoor use only. • Time limited operation for devices without mitigation techniques in 4.2-4.8 GHz band.
Korea	Unlicensed	-41.3 dBm/ MHz	3.1 to 10.2 GHz with mask (Fig.7)	• DAA technology between 3.1-4.2 GHz from 2007 and 4.2-4.8 GHz form 2010.	• Indoor only.
Singapore	Unlicensed	-41.3 dBm/ MHz	3.4 to 10.6 GHz with mask (Fig.8)	• Power restrictions for devices operating without mitigation in the 3.4-4.2 GHz and 4.8-6 GHz (max. -70dBm/MHz)	• Indoor only. • Only transmit when sending information to associated receiver. • Devices must include a 10 second handshake acknowledgment.

3. Regulatory Options for New Zealand

Four regulatory options have been considered. They are:

1. Status Quo – Continuation of individual licensing

This option requires individual assessment of each application and is therefore unsuitable for widespread application of UWB communication technology in New Zealand. Such an approach could be expected to be reviewed again at a future date. The approach is therefore seen as interim.

Applications are likely to be based on a spectrum mask and conditions applicable in the market where the technology was sourced. This could result in a variety of different technical standards operating in New Zealand.

This approach would impose some additional costs on importers and/or applicants and would be not consistent with harmonisation of standards with other countries. It provides a clear regulatory control, although it may not prove practicable to control importation of products not yet licensed over the medium term.

2. A General User licence using the USA spectrum mask

This option establishes a longer term licensing approach, with use of the USA mask. This is the least restrictive mask, which could lead to long term incompatibility between UWB and other licensed services.

The USA emission mask was developed using early studies of pulsed emissions, but not OFDM technologies. The use of two different masks, for indoor and for outdoor use, maximises UWB potential, but may also lead to compliance questions when users deploy systems sold locally to best meet their needs irrespective of the General User Licence restrictions.

3. A General User licence using the European spectrum mask

This option establishes a longer term licensing approach, with use of the European mask. This is more restrictive than the USA mask, and is intended to provide adequate technical protection for fixed microwave and satellite services.

The harmonised approach adopted in Europe is based on a set of ETSI and IEC standards which gives a greater technical robustness to this approach.

4. A General User licence using the Korean/Japanese spectrum mask

This option establishes a longer term licensing approach, with use of the spectrum mask applicable in Korea, Japan and Singapore. This is a hybrid approach which includes some features of both the USA and European requirements. In addition, there are some requirements which are specific to these Asian countries. If adopted, these mitigation techniques could lead to a higher cost implementation in New Zealand.

This approach may be unduly restrictive in New Zealand which does not need the specific requirements of the countries concerned. In addition the countries concerned are still expected to revise their requirements in the near future. Using this spectrum mask would also limit the scope for harmonisation with other markets such as Europe or USA.

Options	Licensing	Spectrum Mask	Degree of restriction in emissions	Include mitigation techniques	Max. Power
1. Status Quo. Continue with interim licensing	Interim test licences	No mask (licence granted on case by case basis)	No mask (licence granted on case by case basis)	No. Licence granted on case by case basis. Requires a low probability of interference only.	Not specific. Licence granted on case by case basis. Requires a low probability of interference only
2. USA	Unlicensed	FCC masks for indoor and outdoor	More relaxed	Not specified.	-41.3 dBm/ MHz
3. Europe	Unlicensed	Harmonised European mask. Indoor only.	More conservative	Yes. Low duty cycle restrictions in the 3.4 to 4.8 GHz.	-41.3 dBm/ MHz
4. Korea, Japan & Singapore	Unlicensed	Hybrid approach plus local requirements	Mixed degrees	Yes. Detect and Avoid (DAA) among other technologies.	-41.3 dBm/ MHz

Question 1:

Do you agree with the above analysis of regulatory framework options for UWB communications?

4. Proposal

After comparing the different regulatory options described in the previous section, the Ministry's view is that the European approach appears to be more technically and operationally robust. It includes sufficient safeguards to protect existing services, while not being overly prohibitive in comparison to the frameworks adopted by Japan or Korea.

The following is a summary of the harmonised regulatory framework adopted by Europe[20], proposed for use in New Zealand:

Licence regime:

- Unlicensed (non-interference and non-protected basis, as per GUL regime in New Zealand)

Max. e.i.r.p:

- -41.3 dBm/ MHz

Frequency:

- 3.1 to 10.6 GHz (with mask as per fig.3)

Mitigation Techniques:

- Low duty cycle restrictions in the 3.4 – 4.8 GHz
- Expects products without mitigation techniques to operate exclusively above 6 GHz in the longer term.

Operational conditions:

- Indoor only. If outdoor, not attached to a fixed location.
- Transmit Power Control for devices installed in road and rail vehicles in the 4.2-4.8 GHz and 6-8.5 GHz.
- Time limited deployment for devices operating in the 4.2-4.8 GHz.

In terms of product harmonisation, the current trend of UWB manufacturers is to develop products that spectrally fit within those bands commonly identified by administrations as more appropriate. For example, those frequency bands above 6 GHz and below 10 GHz have been regulated almost equally by all administrations (maximum e.i.r.p. -41.3 dBm/ MHz). In this regard, Europe has also explicitly identified in Section 18 of the European Commission decision 2007/131 that equipment without appropriate interference mitigation techniques will exclusively operate above 6 GHz in the longer term.

[20] The European Commission Decision can be found at: http://ec.europa.eu/information_society/policy/radio_spectrum/docs/ref_docs/uwb_04_orig_web.pdf

Question 2:

Do you agree with the proposal to implement the European harmonised licensing framework for UWB communication devices in New Zealand?

Question 3:

Do you have suggestions for any other alternatives for regulating UWB communication devices in New Zealand?

5. Next Steps

After analysing the submissions, the Ministry will:

- Report to the Minister on the outcome of the consultation process and recommended approach for future licensing of UWB communication devices.
- Publish the decisions on a regulatory framework for UWB communications.

Appendix A: USA FCC Emission Limits

Frequency (MHz)	e.i.r.p
960-1610	-75.3 dBm/MHz
1610-1990	-53.3 dBm/MHz
1990-3100	-51.3 dBm/MHz
3100-10600	-41.3 dBm/MHz
Above 10600	-51.3 dBm/MHz

Table 1: Summary of Emission Limits for Indoor Communication devices

Frequency (MHz)	e.i.r.p
960-1610	-75.3 dBm/MHz
1610-1990	-63.3 dBm/MHz
1990-3100	-61.3 dBm/MHz
3100-10600	-41.3 dBm/MHz
Above 10600	-61.3 dBm/MHz

Table 2: Summary of Emission Limits for Outdoor hand-held Communication devices

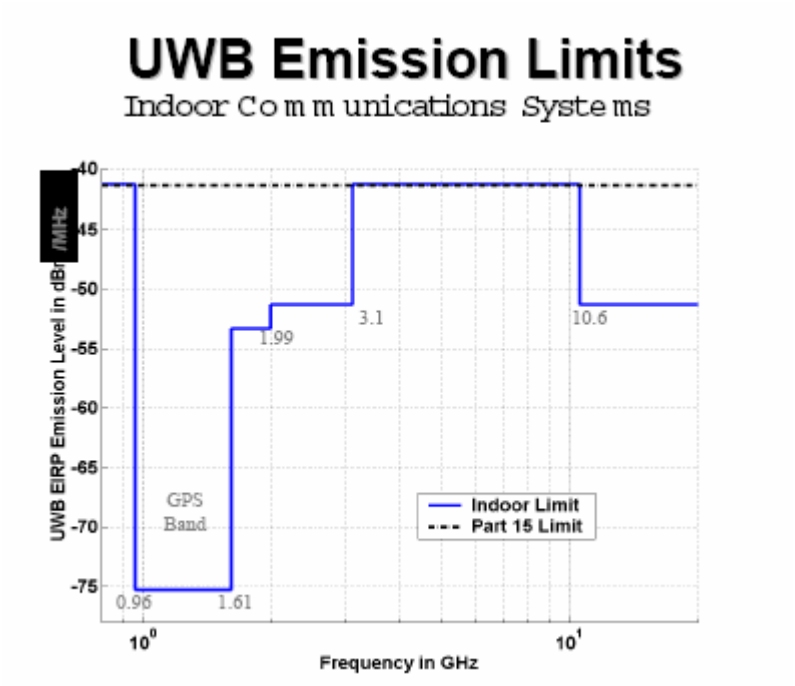

Figure 1: FCC Emission Limits for Indoor Communication systems (source: FCC)

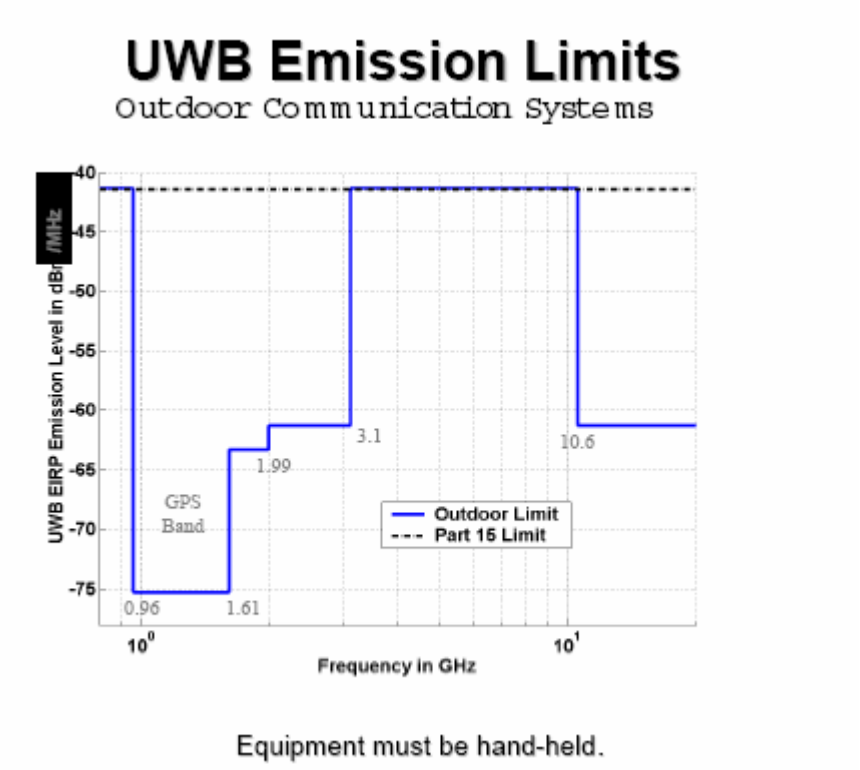

Figure 2: FCC Emission Limits for Outdoor hand-held Communication systems (source: FCC)

Appendix B: Emission Limits: Europe

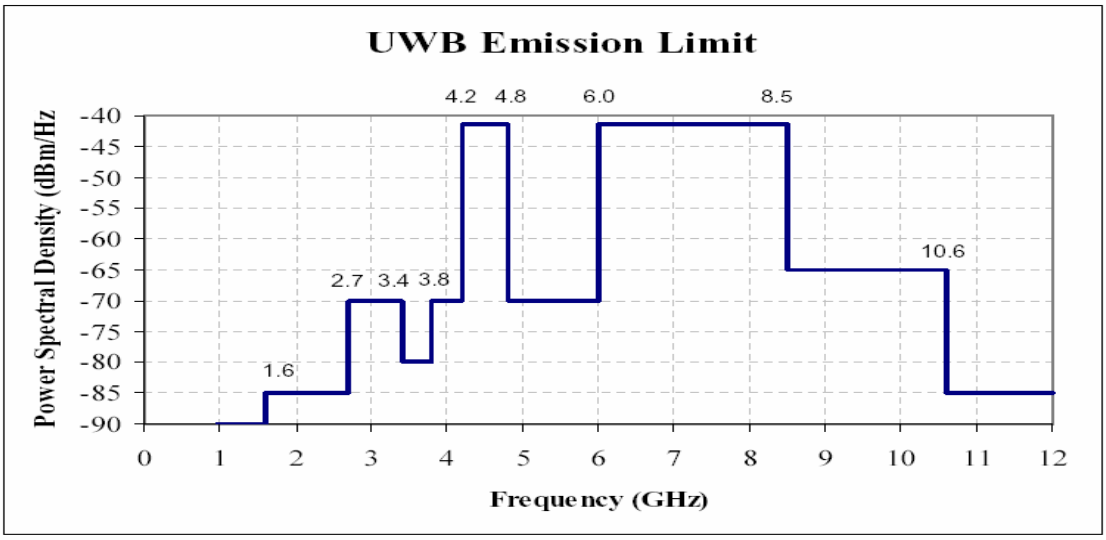

Figure 3: Emission limits in Europe (source: APT/AWF (Amended ECC/DEC/(06)04))

Technical requirements for devices using UWB technology in bands below 10.6 GHz

Maximum e.i.r.p. limits

Frequency range	Maximum mean e.i.r.p. spectral density (dBm/MHz)	Maximum peak e.i.r.p. (measured in 50MHz)
Below 1.6 GHz	–90 dBm/MHz	-50 dBm
1.6 to 2.7 GHz	-85 dBm/MHz	–45 dBm
2.7 to 3.4 GHz	-70 dBm/MHz	–36 dBm
3.4 to 3.8 GHz	-80 dBm/MHz	–40 dBm
3.8 to 4.2 GHz	–70 dBm/MHz	–30 dBm
4.2 to 4.8 GHz **(Notes 1 and 2)**	–70 dBm/MHz	–30 dBm
4.8 to 6 GHz	–70 dBm/MHz	–30 dBm
6 to 8.5 GHz **(Note 2)**	–41.3 dBm/MHz	0 dBm
8.5 to 10.6 GHz	–65 dBm/MHz	-25 dBm
Above 10.6 GHz	–85 dBm/MHz	-45 dBm

Note 1: UWB devices placed on the market before 31st December 2010 are permitted to operate in the frequency band 4.2 - 4.8 GHz with a maximum mean e.i.r.p. spectral density of –41.3 dBm/MHz and a maximum peak e.i.r.p of 0dBm measured in 50MHz.

Note 2: In case of devices installed in road and rail vehicles, operation is subject to the implementation of Transmit Power Control (TPC) with a range of 12 dB with respect to the maximum permitted radiated power. If no TPC is implemented, the maximum mean e.i.r.p. spectral density is -53.3 dBm/MHz.

Figure 4: ECC technical requirements (source: Amended ECC/DEC/(06)04)

Appendix C: Emission Limits: Germany

Frequenzbereich	Maximaler Mittelwert[1)] der spektralen Leistungsdichte		Maximaler Spitzenwert der Leistung	
GHz	Pikowatt/MHz (e.i.r.p.)	dBm/MHz (e.i.r.p.)	Nanowatt (e.i.r.p.)[2)]	dBm (e.i.r.p.)[2)]
0,03 – 1,6	1	-90,0	10	-50,0
1,6 – 2,7	3,16	-85,0	31,6	-45,0
2,7 – 3,4	100	-70,0	251	-36,0
3,4 – 3,8 [3)]	10	--80,0	100	-40,0
3,8 – 4,2 [3)]	100	-70,0	1000	-30,0
4,2 – 4,8 [3)]	100	-70,0	1000	-30,0
4,8 – 6,0	100	-70,0	1000	-30,0
6,0 – 8,5 [4)]	74100	-41,3	1000000	0
8,5 – 10,6	316	-65,0	3160	-25,0
> 10,6	3,16	-85,0	31,6	-45,0

Figure 5: Emission limits in Germany (source FNA, document Vfg 1/2008)

The German administration released their UWB resolution which is harmonised with the European emission limits. This resolution also specifies the requirement for a 10 second handshake signalling between UWB transmitters and receivers. Attention must be given to the suitability of certain mitigation rules for some UWB communications devices. For instance, some applications such as RFID tags would not normally have an embedded receiver. In this case, the 10 second rule may need further review. In this regard, FCC mentions this rule specifically for handheld UWB devices under Subpart 15.519. The EC Decision 2007/131 also includes the 10 second rule for indoor deployment but it does not specify the type of application.

Appendix D: Emission Limits: Japan

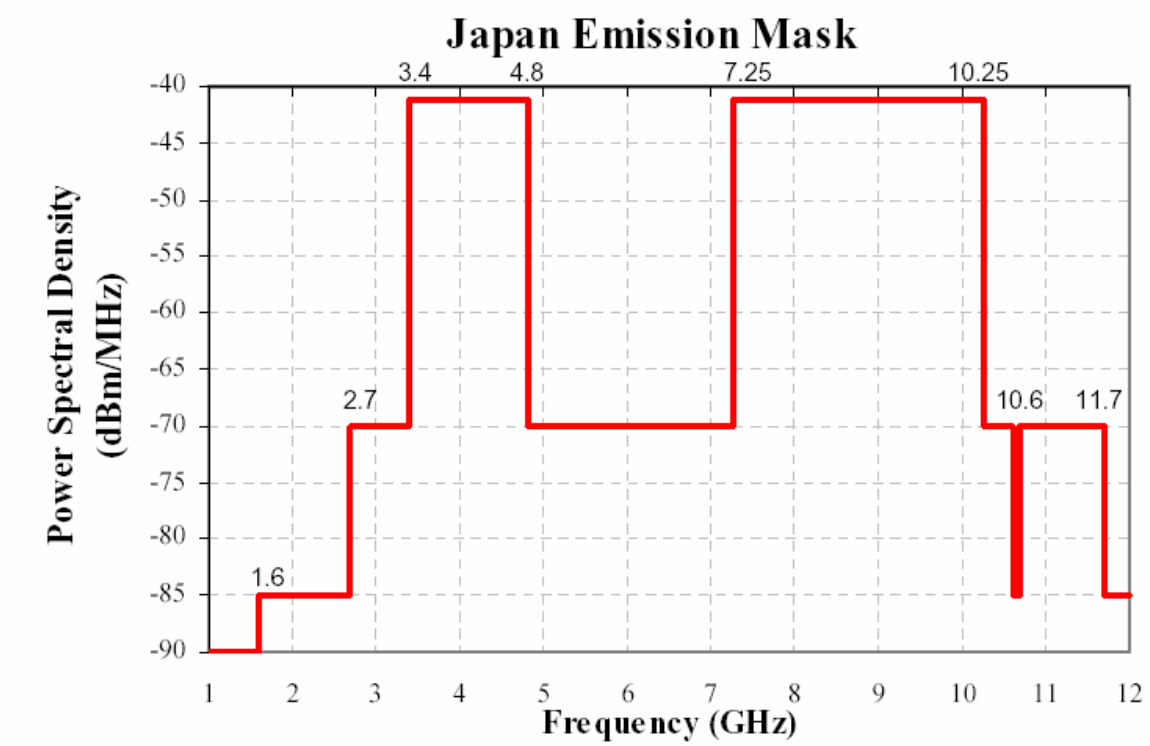

Figure 6: Emission limits in Japan (source APT/ AWF)

The preliminary mask adopted by Japan, specifies limits for indoor only. Japan has considered the operational requirements of UWB devices as well as characteristics of incumbent services. It has proposed a mask that takes into account frequency sharing issues in Japan with services such as passive receivers, systems beyond IMT-2000, ENG and others. Additional mitigation techniques (DAA) have been recommended for UWB services operating between 3.4-4.8 GHz.

Appendix E: Emission Limits: Korea

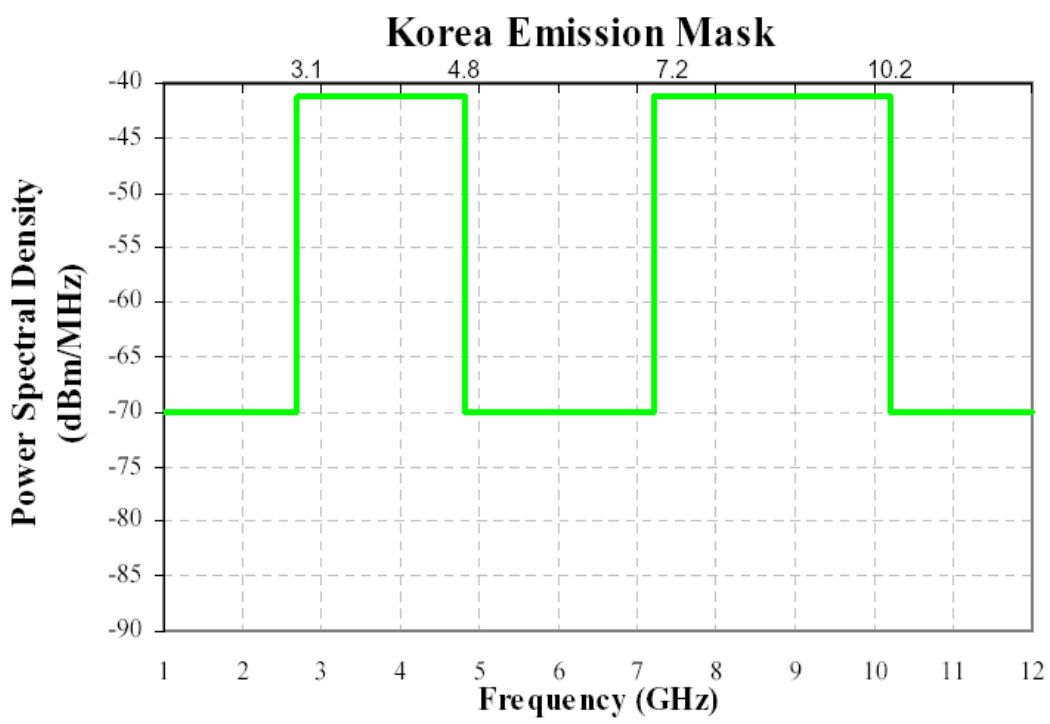

Figure 7: Emission limits in Korea (source: APT/AWF)

The Korean emission limit mask requires the implementation of DAA techniques in the 3.1-4.2 and 4.2-4.8 GHz to provide protection to IMT Advanced systems and broadcasting service.

Appendix F: Emission Limits: Singapore

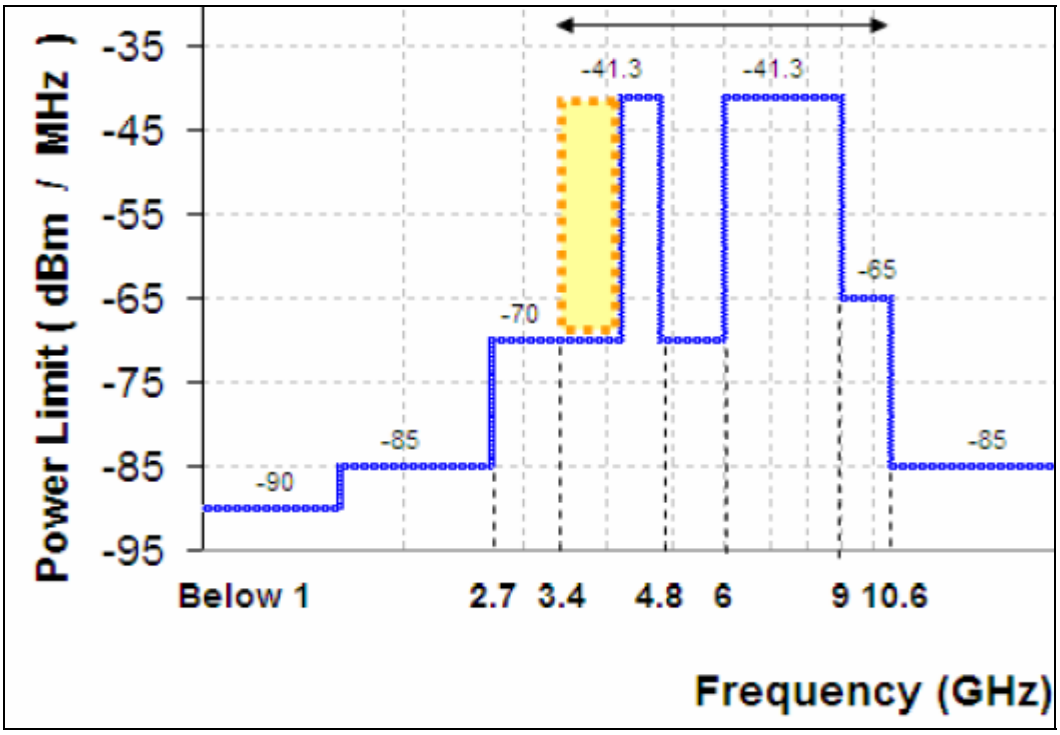

Figure 8: Emission limits in Singapore (source: IDA)

Figure 9: Technical requirements (source: IDA)