An Engineering Discussion Paper

on Spectrum Allocations for

Ultra Wide Band Devices

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Executive Brief

Ultra Wide Band is a wireless technology developed to transmit large amounts of data over very short distances, typically less than 15 metres. With bandwidths of more than 500 MHz, the capacity of UWB devices greatly exceeds that of conventional radio transmitters. UWB devices operate at very low power levels, enabling them, in theory, to share spectrum with traditionally licensed services over a wide range of frequencies without adverse impact to those services.

A potential application of UWB is for high-speed wireless networking in the workplace or at home. Other applications include ground penetrating radar for geological surveys and search and rescue, wall penetrating imaging in construction, vehicular radar for collision avoidance, medical imaging, and hand-held communication and measurement systems.

The UWB applications considered in this engineering discussion paper are:

- *UWB communication devices,*
- *UWB imaging systems, and*
- *UWB vehicular radar.*

The uptake of UWB technologies is expected to encourage the development of innovative products and widen consumer choice in the radiocommunications market. UWB is well supported by improvements in silicon technology and has many potential low power, low cost, miniature applications.

The biggest risk of licensing UWB devices is their potential to interfere with existing licensed services such as public safety services and commercial services.

This paper considers appropriate technical standards and possible spectrum allocation options for UWB in New Zealand. It considers a number of issues for industry and other stakeholders to comment on.

Submissions close on 8 May 2005.

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GLOSSARY

ACA	Australian Communications Authority
CEPT	Conference of European Posts & Telegraphs
EC	European Commission
e.i.r.p	equivalent isotropically radiated power
ETSI	European Telecommunications Standards Institute
FCC	Federal Communications Commission (USA)
GPR	Ground Penetrating Radar
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
NTIA	National Telecommunication Information Administration (USA)
OfComm	Office of Communications (UK)
PAN	Personal Area Network
RF	Radio Frequency
RRD	Restricted Radiation Device
SARA	Short-range Automotive Radar frequency Allocation
SG	ITU-R Study Group
TG	ITU-R Task Group
UFZ	UWB Friendly Zone
UWB	Ultra Wide Band
WG	ITU-R Working Group
WLAN	Wireless Local Area Network

1 INTRODUCTION

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). Traditionally, use of the radio spectrum has been granted to individual users through radio licences and spectrum licences. Increasingly, the Ministry has also granted access to selected frequency bands through the assignment of General User Licences (GULs), which allow the spectrum to be shared by many users, who need not pay any fees. GULs promote innovation in new technology that benefits consumers and businesses and promotes the efficient utilisation of the radio spectrum. These licences are particularly suited to portable ubiquitous devices such as wireless local area networks (WLAN) and garage door openers. Ultra wide band (UWB) is an emerging technology that could potentially challenge current paradigms for the allocation and use of the radio spectrum.

A potential application of UWB is for high-speed wireless networking in the workplace or at home. Other applications include ground penetrating radar for geological surveys and search and rescue, wall penetrating imaging in construction, vehicular radar for collision avoidance, medical imaging, and hand-held communication and measurement systems.

The Ministry needs to strike a balance between encouraging new technologies such as UWB and safeguarding existing 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. There is also an increased risk of non-compliant UWB devices being imported illegally into New Zealand, which could result in interference to existing spectrum users.

This paper discusses appropriate technical standards and possible spectrum allocation options for UWB in New Zealand. It considers a range of issues for industry and other stakeholders to comment on.

The Ministry anticipates that with the future development and proliferation of UWB devices in New Zealand and worldwide, further reviews of spectrum allocations and underlying technical parameters for UWB will be necessary.

2 GENERAL CHARACTERISTICS OF ULTRA WIDE BAND TECHNOLOGY

Ultra wide band is a wireless technology developed to transfer data at high rates over very short distances at very low-power densities. Although often considered a recent breakthrough in broadband wireless technology, the concept of UWB dates back many decades. The technology stems from work in the early 1960s on time-domain electromagnetics.[1] The early UWB systems, designed for the United States (US)

[1] R. J. Fontana, "Recent System Applications of Short-Pulse UWB Technology", *IEEE Trans on Microwave Theory and Techniques,* vol. 52, no. 9, pp. 2087-2104, Sep. 2004.

military and government agencies, included such applications as covert (low probability of detection and intercept) radar and communication systems. Recent advancements in chip development have made UWB more viable for commercial and civilian use.

UWB technology, as the name suggests, generally involves the radiation, reception and processing of very wide bandwidth radio frequency emissions. The main reason for such high bandwidths is that UWB devices send out tiny bursts of radio signals over many frequencies. Data goes out in millions of pulses per second and is re-assembled by a receiving UWB device. Most other wireless technologies use a single radio frequency carrier.

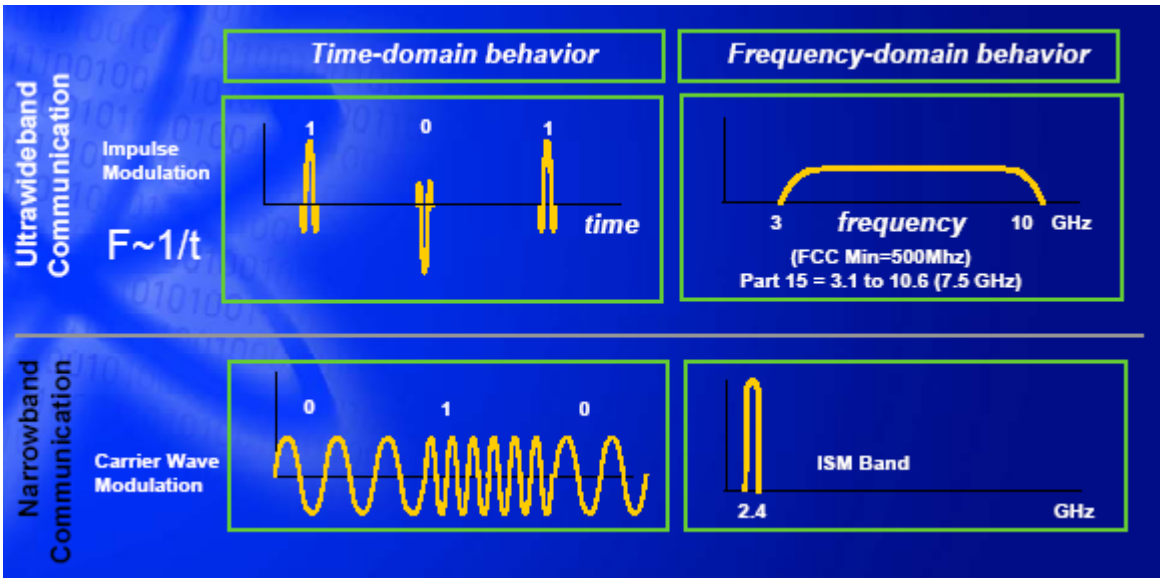

Figure 1: Impulse based waveforms compared with continuous carriers

***Source: Intel.com*[2]**

2.1 Definitions

UWB is not a radiocommunications service as defined by the International Telecommunications Union (ITU). At this stage, it is regarded as a new wireless technology that is being used to develop many wireless applications.

An UWB radio system or device is defined by the US Federal Communications Commission (FCC) and the ITU as *using radiofrequency emissions with bandwidths greater than or equal to 500MHz or with a fractional bandwidth greater than or equal to 20%*.

[2] Intel Paper: The Promise of UWB - Hype or reality
http://www.ida.gov.sg/idaweb/doc/download/I2105/4_-_Intel_-_Hype_or_Reality.pdf

The bandwidth is measured at -10 dB points on either side of the peak emission. If these upper and lower points are represented by f_H and f_L, respectively, the fractional bandwidth can be derived as:

$FBW(\%) = 2(f_H-f_L)*100 / (f_H+f_L)$

This bandwidth greatly exceeds that of other radio transmitters, which are generally confined to a narrow frequency band allocated for a specific service.

As a consequence of occupying a large bandwidth, UWB devices can span a number of bands normally assigned to 'traditionally licensed' users. However, as the level of emissions from UWB is very low and below the power floor of existing frequency users, they are able to share spectrum with existing services.

Issue 2.a

The Ministry invites comments on the adequacy of the above definitions and any proposals for alternative definitions for UWB technology.

2.2 Legislative Considerations

Management of the radio spectrum is achieved through administrative licensing (radio licences) or through the creation of management rights over particular bands, with the manager creating spectrum licences for operation within that management right band. The design of UWB equipment is such that, in many cases, its operation may include frequencies that are administratively licensed as well as frequencies where management rights have been created. The ability of UWB equipment to operate below the noise floor of existing users means that it is possible under current legislation to provide administrative licensing for this new technology.

Amendments to the Radiocommunications Act (the Act) in 2000 provide for a power floor as a boundary to management rights. In the absence of any defined limits, the power floor of a management right is -50 dBW (or -20 dBm) and is defined as "the minimum level of emissions, expressed in terms of equivalent isotropically radiated power, specified in a record of management rights." In simple terms, a manager of a management right is able to create spectrum licences and control (wanted and unwanted) emissions above the power floor limit (typically -50 dBW). Under s110 of the Act, the spectrum below the power floor is administered by the Crown, which can issue radio licences. The intended power of UWB devices is well below power floor limits[4].

4 The FCC in band emission limit for UWB is -41.3 dBm. The out of band limits are:
-51.3 dBm for indoor systems and
-61.3 dBm for outdoor systems
As a comparison, the default power floor in New Zealand is -20 dBm (-50 dBW).

The Crown has previously licensed transmissions for operation below the power floor of a management right. Low power audio senders, which operate below the power floor of the management right used for FM broadcasting, are licensed under a General User Radio Licence (GURL) for Short Range Devices[5].

In exercising its ability to grant a radio licence under Regulation 12 of the Radiocommunications Regulations 2001, the Crown must consider technical compatibility with existing radio and spectrum licences.

2.3 Opportunities

Economic indicators for 2005 published by the Ministry and Treasury show New Zealand's performance in innovation as still "low" but improving relative to OECD standards. Adoption of new technologies such as UWB is one way of encouraging innovation. UWB is well matched with improvements in silicon technology and has many potential low power, low cost, miniature applications. This could provide an opportunity for New Zealand businesses to create new markets and industries for innovative products that provide greater choice for consumers. The capability of UWB to transmit large amounts of data at low power levels could reduce costs for businesses and end-users, contributing to increased productivity.

UWB emissions are especially resistant to the effects of multi-path fading, especially observed in mobile and in-building environments. This occurs when a strong reflected wave (e.g. off a wall, ceiling, vehicle, or building) arrives partially or totally out of phase with the direct path signal, causing a reduced amplitude response in the receiver. By employing a wide range of frequencies, UWB emissions are able to penetrate dense objects (including walls and the ground) rather than bounce off them, thus eliminating the effects of multi-path cancellation. Due to very short pulses, even in instances where an UWB emission reflects off an object, the emissions on the direct path have been processed before the emissions on the reflected path arrive and no cancellation occurs.

UWB devices are also able to transmit very high data rates at low power levels and are consequently well suited to high-speed, mobile or portable wireless applications. UWB emissions are more difficult to detect than conventional radiocommunication signals and are potentially more suitable for secure communication systems.

UWB devices are intended to be simple, low cost systems designed to operate with large numbers of users occupying the same spectrum. Coding techniques and time correlation eliminate the need for frequency separation or channel allocation. This offers the potential to significantly increase the efficiency of spectrum utilisation.

2.4 Risks

As a relatively new technology operating in the same radio frequency bands as current users, there are potential interference risks. A number of technical studies have been conducted by several administrations and standards bodies to assess the potential

[5] See (http://www.med.govt.nz/rsm/licensing/gurls/gurl-srd.html)

interference from UWB devices to existing services. These studies have been founded on varying assumptions such as the desirable levels of protection to existing services or the likely penetration of UWB devices, among others. The findings of these studies have, so far, been inconclusive.

Interference concerns are focused on two main areas:

- services that by their nature operate at very low-received powers, such as satellite services, and
- interference caused to receivers working at more normal power levels, through the aggregation of many UWB devices.

In the case of low-received power services, it may be necessary to limit UWB emissions in the proximity of the frequency bands for these services. For example, the FCC (US) restricts UWB emissions in the vicinity of Global Positioning System (GPS) frequencies.

In the case of receivers operating at more normal powers, interference concerns mainly focus on aggregated emissions from UWB devices. The interference potential of large numbers of such devices is the subject of ongoing study by a number of international forums. For instance, the use of UWB applications for wireless communications and vehicular radar could become ubiquitous, spanning bands currently used by a variety of other services. While the emissions from each UWB device are expected to be below the noise floor, each device will contribute to and may slightly elevate the noise floor. Therefore, there may be a point where aggregate emissions from UWB devices start to cause interference to existing users. This ‘aggregation problem’ may be mitigated by the short-range nature of most of these devices, many of which are designed for indoor use.

Issue 2.b

The Ministry invites comments on the potential benefits and risks associated with the introduction of applications using UWB technology.

3 UWB APPLICATIONS

UWB is being used to develop several new wireless applications, including consumer communication devices, imaging services and vehicular radar. These applications are considered in the following sections:

3.1 Imaging Radar Systems

The needs of the military for systems that can identify camouflaged and buried objects or installations had been the main driver in the development of UWB imaging systems. The use of these systems has now expanded from military to public security and protection purposes. For example, UWB radar systems could be used to locate persons hidden underground or behind objects or debris in crisis or rescue situations.

Frequencies in the lower part of the radio spectrum (<1 GHz) could penetrate ground and wall surfaces and are useful in the detection of buried objects such as bodies and in providing through-wall security monitoring.

UWB technology has been used for some time in ground-penetrating radar applications and is currently being developed for innovative types of imaging systems for medical (diagnostic) and industrial use. UWB imaging devices are also beginning to be used in the building construction and maintenance industry to locate and measure reinforcement bars in concrete and electric wiring and pipes inside walls and thick foundations. Because imaging radar devices are used infrequently, their deployment in New Zealand is expected to be sparse.

The frequency bands considered for imaging are: below 960 MHz, 1900 to 10600 MHz, and 3100 to 10600 GHz.

3.2 Vehicular Radar Systems

Vehicular or automotive radar systems are currently promoted as the first widespread civilian use for UWB technology. These systems aim for a high range and position accuracy and could be used to improve automotive safety in the form of collision avoidance systems, safer deployment of airbags, restraint system arming, and parking assistance.

UWB is considered to be more cost effective than conventional technology for high precision radar systems, making it more economical and affordable to use in enhancing the safety features of vehicles in the future.

UWB for vehicular radar application is envisaged to operate near 24 GHz. As these devices may become pervasive and their operation is mostly mobile and outdoors, the potential to interfere with other services may increase over time.

The development of an international standard for UWB automotive radar is a pressing issue for New Zealand. A global alliance of motor vehicle and electronics manufacturers is developing an international standard, known as Short range Automotive Radar frequency Allocation (SARA), which utilises a combination of conventional and UWB radar devices. The Ministry was approached by the alliance's representatives in early 2004, who were hoping that regulations would be in place worldwide by the end of 2004, to enable implementation in 2005. Their proposal incorporates the recent FCC standard for UWB vehicular radar. The Ministry also received enquiries from an automotive distributor in New Zealand on importing UWB radar-enabled vehicles based on SARA.

The FCC emission mask of intentional emissions of UWB vehicular radar spans the 22.0 GHz – 29.0 GHz range. These in-band and out-of–band limits are reproduced in more detail in Table 6. The current GURL for Short Range Devices in New Zealand only covers the 24.0 - 24.25 GHz band. Operating a 24 GHz collision avoidance radar

conforming to the FCC limits (or even the Draft ETSI EN 302 2878-1 Standard) in New Zealand would therefore constitute an infringement[6].

The emission mask of intentional emissions of UWB vehicular radar would overlap with the internationally allocated Radio Astronomy band of 23.6 - 24.0 GHz to which International Radio Regulation (IRR) No. 5.340 applies. This regulation states that all emissions are prohibited in this band. Therefore, operating a 24 GHz vehicular radar in New Zealand would currently be in violation of IRR. In the US, vehicular radar emissions within the 23.6 - 24 GHz band that appear 30 degrees or greater above the horizon by 25 dB below the limits specified in Table 6 have to be attenuated.

New Zealand could choose to invoke Article No. 4.4. of the IRR[7] if it is satisfied that operation of the devices would not cause interference to radio reception outside its sovereign territory. Due to the isolation of New Zealand and the low e.i.r.p. of UWB devices, it is unlikely that these devices would cause interference to radio reception outside the country. There are currently no licences recorded in the 23.6 – 24.0 GHz band, although there may be some receive-only Radio Astronomy use.

The regulatory developments in Asia on vehicular radar are not clear at this stage. UWB vehicular radar-enabled automotives are expected to become available in Europe after July 2005.

3.3 Wireless Communications Systems

The use of UWB technology in communications systems evolved during the 1980s to meet the needs of US government agencies, especially for communications systems with low intercept and detection probability. Today, interest in UWB devices extends to civilian use. One major advantage of UWB is that very high data rates are possible at low power levels. UWB communications devices are expected to operate in the 3.1 - 10.6 GHz band.

Future UWB communications systems are likely to be for applications catering to the general public: Personal Area Networks (PAN), Wireless Local Area Networks (WLAN), enabling such applications as connecting laptops wirelessly to the office LAN; wireless data streaming from a camcorder to the hard drive of a PC; and delivering wireless connections between stereo-systems, DVD players, computers, displays and speakers, which could simplify the installation of consumer devices at the same time remove unsightly wires.

At the Consumer Electronics Show held in the US in January 2005, a prototype of an UWB-enabled cell phone demonstrated by Motorola and Freescale Semiconductors connects wirelessly to a laptop and downloads photos taken by the phone or MP3 files from the Internet. This could mean that the merging of cellular technology with UWB is

[6] Clause 37f of the Radiocommunications Regulations.
[7] Article 4.4 states that Administrations shall not assign to a station any frequency in derogation of the Radio Regulations, except on the express condition that such a station, when using such a frequency assignment, shall not cause harmful interference to, and shall not claim protection from harmful interference caused by, a station operating in accordance with the provision of ITU rules.

not a remote possibility and that UWB communication devices may become a common feature in most computing and communications devices.

Issue 3.a

The Ministry invites comments on the future demand for UWB imaging, vehicular radar and wireless communications system applications in New Zealand, along with comments on any sharing issues. The Ministry also invites views on the existing and planned receive-only Radio Astronomy use in the 23.6 - 24.0 GHz band in New Zealand.

4 OVERSEAS REGULATORY DEVELOPMENTS

A number of initiatives are being undertaken worldwide to develop standards and regulations for the introduction and use of UWB devices. However, the development of an international regulatory framework has been slow, owing to concerns about their impact on existing services. At present, the US is the only market where UWB devices are allowed to be operated without a licence.

4.1 ITU

The ITU initiated UWB-related work through its Radiocommunications Sector (ITU-R) Study Group 1 (SG1), which considers general spectrum management matters. In 2002, task group TG1/8 was formed to study and advise on various aspects of UWB.

TG 1/8 is comprised of four working groups:

- WG1: UWB Characteristics
- WG2: UWB Compatibility/ Impact on other radio systems (14 subgroups)
- WG3: Spectrum Management Framework
- WG4: Measurement Techniques

TG 1/8's work is scheduled to be concluded and presented to SG1 by October 2005. The Ministry is an active participant of this task group.

The findings of the technical studies being conducted by TG 1/8 are expected to have a strong influence on many administrations' future regulatory arrangements for UWB.

4.2 IEEE

The UWB standardisation process in the Institute of Electrical and Electronic Engineers (IEEE) is considered primarily by two task groups:

- IEEE 802.15.3a, which is developing a standard for the physical layer of wireless PANs at data rates above 100Mbits/s, and

- IEEE 802.15.4a, which is considering standards for UWB short-range wireless applications with data rates from 500kbits/s up to a few Mbits/s.

These standards are expected to be developed by the end of 2005.

4.3 CEPT & ETSI

4.3.1 UWB Communications and Imaging Devices

The use of UWB is currently not permitted in the European Union (EU). In March 2004, 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. CEPT's work on UWB communication systems, particularly its study on coexistence criterion between UWB and existing users, is expected to be completed sometime this year (2005).

The European Telecommunications Standards Institute (ETSI) was mandated by the EC in February 2003 to investigate and develop generic and specific ETSI radio standards for short–range UWB devices, identify spectrum requirements, and ensure spectrum efficiency and compatibility with other radio services and devices. Since then, ETSI has been developing three standards: EN 302 065 (for UWB communication devices), EN 302 066 (for ground and wall penetrating radar devices) and EN 301 091 (for automotive radar systems). At present, ETSI is awaiting input from the CEPT to complete its work.

The proposed ETSI emission mask for UWB indoor communications systems currently being considered within CEPT and ETSI envisages introducing additional limits on UWB transmissions at the edges of the 3.1 to 10.6 GHz band as compared to the FCC emission limits for indoor UWB systems. For instance, a -65dBm/MHz limit is proposed at 2.1 GHz. The UK (OfCom) proposes a limit at 2.1 GHz, even tighter than the proposed ETSI limit discussed in Sec 4.5. These masks are depicted pictorially in Appendix C – Proposed Emission Limits – Europe.

A decision by the EC, following the completion of CEPT's work, would be binding on member states of the EU.

4.3.2 UWB Vehicular Radar Devices

The 79 GHz band has been identified by the CEPT as the most suitable band for the long term development and deployment of automotive short-range radar. However, as the technology is still under development and not immediately available on a cost-effective basis, the CEPT has identified the 24 GHz band as a temporary solution to enable the early introduction of vehicular radar in the EU. Pursuant to this, the EU has decided to designate and make available the 24 GHz band[8] for vehicular radar services as soon as possible (no later than 1 July 2005).

[8] 21.65 -26.65 GHz

Additional EU restrictions on UWB vehicular radar:

- The 24 GHz band is made available to vehicular radar on a non-interference and non-protected basis.
- Total number of vehicles registered, placed on the market or put into service equipped with any automotive short–range radar (not necessarily UWB) in each EU Member State should not exceed 7% of the total number of vehicles in circulation in each Member State.
- This band may remain available for vehicular radar only until 30 June 2013[9].
- The radiated emissions in the 24 GHz band must not exceed -41.3 dBm/MHz e.i.r.p. and for frequencies below 22 GHz. The emissions must be limited to -61.3 dBm/MHz e.i.r.p.
- To protect Earth Exploration Satellite Systems at 23.6-24.0 GHz, vehicular radar systems emissions have to be attenuated (by 25 dB below limits given above for vehicles placed on the market before 2010 and thereafter by at least 30 dB) within the band when directed 30 degrees above the horizon.

4.4 United States of America

The US was the first country to adopt regulatory arrangements relating to UWB and is still the only market where UWB devices can be legally operated (without a licence). The FCC, however, has placed stringent conditions concomitant to the use of these devices.

The FCC initiated its UWB proceedings in 1998 and issued its First Report and Order (Rules and Regulations) in February 2002, in which it amended its Part 15 rules on unlicensed radio devices to allow the operation of UWB devices. A new subpart (F) was created specifically to cover UWB devices[10]. Under subpart F, there is a broad range of requirements for the registration of UWB devices. This includes the coordination of some UWB devices with the US regulatory Bodies - the FCC and the National Telecommunication Information Administration - and restrictions on the marketing, supply and operation of these devices. Further, UWB devices cannot be used in toys and are prohibited aboard an aircraft, a ship or a satellite.

The FCC has defined three specialized UWB device classes with different technical standards and operating restrictions based on their potential to cause interference. The emission limits are outlined in Appendix B – USA FCC Emission Limits.

The FCC has decreed that any radiated emissions at or below 960 MHz from any UWB device shall not exceed the emission levels in Section 15.209 of the FCC Part 15 Rules[11].

[9] As long as there is no harmful interference caused to other users in that band and the threshold of 7% has not been reached
[10] FCC Part 15 Subpart F can be referred to at http://www.atlasce.com/15subpartF.pdf
[11] This can be referred to at http://www.fcc.gov/oet/info/rules/part15/part15_1_26_05.pdf.

4.4.1 UWB Communications 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 believes that this limit will ensure that unlicensed UWB devices do not cause 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.

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.
- They can only transmit when the intentional radiator is sending information to an associated receiver.

Additional restrictions placed on handheld outdoor UWB communication systems:

- They must be relatively small hand-held devices.
- 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.

4.4.2 UWB Imaging Systems

The FCC has ruled that UWB imaging systems, including medical imaging and ground-penetrating radar (GPR), can operate in the following bands:

- below 960 MHz,
- 1900 to 10600 MHz, and
- 3100 to 10600 GHz.

Most of these devices can only be operated by specialist organizations such as licensed healthcare groups, law enforcement agencies, emergency rescue services, scientific research institutes, and construction and mining companies. All UWB imaging devices have to be coordinated through the FCC before the equipment can be used.

4.4.3 UWB Vehicular Radar Systems

In the US, UWB vehicular radar systems can operate in the 22-29 GHz band.
Some of the FCC technical requirements are given below:

- These devices can operate only when the vehicle is operating (e.g. the engine is running).

- The centre frequency and the frequency at which the highest level emission occurs must be greater than 24.075 GHz.
- The radiated emissions between 22-29 GHz shall not exceed -41.3 dBm/MHz.
- To protect Earth Exploration Satellite Systems at 23.6-24.0 GHz, emissions from vehicular radar systems are required to be attenuated (by 25 dB below the limits in Table 6) within the band when directed 30 degrees above the horizon.

4.5 United Kingdom

The use of UWB is currently not permitted in the European Union. OfCom, the spectrum regulator in the UK, published a consultation document on a harmonised European position on UWB devices in January 2005, which seeks comments on whether UWB should be allowed or not, and if allowed, what the most appropriate technical limits would be.

The OfCom consultation document is confined to the consideration of UWB communications devices in the 3.1-10.6 GHz band. OfCom considers that given the likely applications for UWB technology, it will be appropriate to exempt most UWB devices from a licensing requirement, subject to their operation within defined limits. The consultation document is largely driven by concerns that the US specification is inappropriate for the UK (and Europe). OfCom's proposal is that if UWB is allowed, it should be limited to the same in-band power levels as permitted in the US but with tighter out-of-band limits. OfCom proposes an emission mask that falls from -41dBm/MHz at 3.1 GHz to -85dBm/MHz at 2.1 GHz for indoor communication systems. It believes that the risk of interference to services below 3 GHz, such as 3G operators in their currently licensed spectrum, can be reduced to insignificant levels by applying such a mask.

Comparisons between the FCC mask, proposed ETSI mask and the proposed OfCom mask for indoor communications are graphically depicted in Appendix C – Proposed Emission Limits – Europe.

4.6 Australia

Australia has, so far, adopted a cautious approach. Since publishing a "Background Brief" on UWB in May 2003, the Australian Communications Authority (ACA), the spectrum regulator of Australia, has issued a few interim apparatus licences (akin to radio licences in New Zealand) since April 2004 for the use of ground penetrating radar (GPR) systems. This is the first example of an application using UWB technology that has been licensed in Australia and it has, at this stage, been authorised under a temporary "scientific assigned" licence. A key element in the interim licensing arrangements is an interference control condition that restricts stray radiofrequency signals caused by the operation of these UWB GPR devices.

The view of the ACA at this stage is that only applications with low potential to cause interference will be authorised under these interim licensing arrangements.

4.7 Canada

In February 2005, Canada published a Consultation Paper on the introduction of UWB wireless systems, seeking public interest and comment on UWB technology. Canada expects public comments on the paper to provide important input for the development of specific spectrum policy provisions and radio equipment standards for the introduction and use of UWB systems in Canada.

4.8 Asia

4.8.1 Japan

In Japan, the Ministry of Public Management, Home Affairs, Post and Telecommunications, the Japanese spectrum regulator, has proposed to issue experimental licences until it issues its formal UWB regulations, which is expected to take place by the end of 2005.

4.8.2 Singapore

Infocomm Development Authority (IDA), the spectrum regulator of Singapore, launched its UWB programme in February 2003. Trial regulations have been 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. A UWB emission mask of 6dB above the general FCC Part 15 level from 2.2 GHz to 10.6 GHz has been imposed to encourage experimentation in the UFZ. No intentional emissions are allowed below 960MHz. The progress of UWB trials is monitored by the IDA to ensure existing wireless services are not affected. The UFZ will be available until the IDA formally announces its UWB regulations, which the IDA considers will be based on the ITU-R recommendations.

Issue 4.a

The Ministry invites comments on the FCC proposals for different UWB applications and their applicability to New Zealand.

Comments are also invited on the UK proposal for UWB indoor communication devices in comparison to the FCC limits and the ETSI limits.

Further, comments are invited on the European Union proposal on vehicular radar and the applicability of the proposed parameters to New Zealand.

4.9 Conclusions

Worldwide regulatory developments for UWB appear to be gathering momentum, with several countries publishing consultative documents this year based on modifications to the FCC technical parameters.

Most countries and standards bodies, however, appear to be awaiting the ITU-R TG 1/8 results, expected to be available by October 2005, before making any definite regulatory decisions.

5 LICENSING OPTIONS

5.1 Overview

There are four possible deployment options for UWB use (and associated interference issues):

(i). *Specialist use only*
This restricts UWB use to specialist imaging and radar devices (e.g. Ground Penetrating Radar) that have limited demand and are used intermittently. Interference problems are not envisaged except in worst-case scenarios.

(ii). *Specialist use as above and automotive radar (SARA proposal) only*
In addition to the comments above, this will only potentially affect a limited number of other services near the 24 GHz band.

(iii). *Relatively ubiquitous deployment of devices, with use restricted to indoor or handheld devices, and specialist and automotive radar applications as above*
There is a small risk of interference from aggregate devices to services operating in the 3.1 - 10.6 GHz band.

(iv). *Ubiquitous use to include applications that require non-handheld outside transmission such as mobile telephony (i.e. base stations) in addition to the applications in (iii) above*
The interference risk to existing services could be significant and unpredictable. This application has not yet been authorised by the FCC.

The Ministry view is that these differing levels of UWB use could be considered progressively for licensing in New Zealand with different levels of regulation.

Issue 5.a

The Ministry invites comments from industry on the extent to which UWB should be allowed in New Zealand and preferred timings.

As outlined earlier, the legislation provides for the granting of licences:

(i) on an individual basis (spectrum or radio licences); or
(ii) on a general basis, whereby any person may use a device provided certain operational criteria (such as power output or frequency of operation) are met.

There are a number of features of the two licensing systems that assist in determining whether to license use on an individual or on a general basis.

Radio licences are generally issued where there are “quality of service” expectations. To meet these expectations, individual licences are issued on a basis that provides both a right to transmit and an associated expectation of receiver protection. These licence parameters are determined on well developed engineering principles, thus, licensees have confidence that their quality of service expectations will be met and their investment will continue to be protected from any licences created in the future.

The process of issuing radio or spectrum licences includes the documentation of suitable information that allows technical compatibility assessments to be undertaken and assisting in resolving interference, should it occur.

GULs are typically issued in situations where there is a ubiquitous service requirement. Usually they are for high volume, portable devices. As it is not possible to determine when and where these devices will be used, licensing is offered on a “non-interference basis” (they are not to cause interference to existing licensed services and any interference received from other users operating in accordance with individual licences must be tolerated.) Often there are low “quality of service” expectations for devices or technologies operated under a GUL. In recent years, equipment suppliers have been introducing “self-management” tools to reduce the effects of interference. For example, a cordless telephone may detect that a channel is being occupied by another user and select an alternative or vacant channel for operation.

GULs do not generally require information about implementation to be recorded. Consequently, individual interference assessments are not undertaken and little information is available in resolving ensuing interference problems.

These broad characteristics outlined above have been considered in the discussion of the following licensing options.

Initial indications are that UWB devices will suit a general licensing approach in the longer term as:

- many of the applications are of a ubiquitous nature and
- they are designed to share spectrum space with other devices.

5.2 Delay Licensing of UWB

One of the options available to New Zealand is to delay making any decisions on UWB until the technology matures. Such inaction is likely to have an economic cost for companies unable to implement the new technologies. It could also create an undesirable outcome for spectrum users in New Zealand if non-compliant UWB devices are imported illegally, which may be inevitable as UWB devices gain wider application overseas. If UWB is introduced as a consumer technology in our major trading partners, it would be difficult and potentially economically detrimental to prevent their use in New Zealand on a similar basis.

5.3 Spectrum Licensing for UWB

The Crown has to create Management Rights (MRs) before any spectrum licences can be created. Section 11A of the Act prevents the creation of two MRs for any particular frequency. The existence of MRs within the bands of interest means that spectrum licensing is not possible for UWB within the current legislative framework.

5.4 Radio Licensing for All UWB Applications

It is possible to issue radio licences for some types of UWB imaging applications due to the nature of their use and limited geographical proliferation. However, for most UWB applications such as communications devices and vehicular radar, which are expected to be of a ubiquitous nature, occupying bandwidths up to 100 times greater than conventional communication systems, traditional licensing approaches may not be suitable.

5.5 Radio Licensing for UWB Imaging Systems Only

The Ministry considers (as discussed in Section 5.2) that it may be possible to issue radio licences for such UWB imaging applications as GPR, wall imaging and through-wall imaging systems, with the operation of such devices being restricted to such specialist organizations as law enforcement agencies, fire and emergency rescue organizations, scientific research institutes, and commercial mining and construction companies.

5.6 General User Licensing for All UWB Use

GULs provide for the spectrum to be shared by many users on a non-interference basis. Since most UWB applications are of a ubiquitous nature, occupying bandwidths up to 100 times greater than normal and have the potential to share spectrum space with other devices, the Ministry is of the view that UWB applications would suit a general licensing approach in the longer term. This will be comparable to the “Unlicensed” approach taken by the FCC for UWB.

As a parallel example, a GUL for Short Range Devices which operate below the power floor of the Management Right used for FM broadcasting already exists in New Zealand.

5.7 General User Licensing for UWB Specialist Use Only

It is possible to issue GULs only for those UWB applications that have limited demand and are expected to be used intermittently (e.g. GULs for imaging and radar devices), with the proviso that they be registered with the Ministry and will be used only by

specialist organizations, including law enforcement agencies, licensed healthcare groups, rescue services, and mining companies.

Issue 5.b

The Ministry invites comments on industry's preferred options for licensing UWB and timings.

6 INTERIM NEW ZEALAND STRATEGY

A number of technical studies on UWB are currently taking place worldwide, especially within ITU-R TG 1/8, and regulatory developments for UWB are still being finalised. This is to ensure that UWB devices can co-exist and are compatible with existing services such as GPS, satellite services and 3G cellular. More definitive regulatory decisions will be considered by the Ministry once ITU-R TG 1/8 standards and compatibility studies are more mature, which is likely to be near the end of 2005.

In the interim, to enable New Zealand companies to take advantage of the benefits offered by UWB, the Ministry is considering to grant interim radio licences for UWB applications with low potential to cause interference on a case-by-case basis. This is in line with the approach currently undertaken by Australia.

Issue 5.c

The Ministry invites comments on the strategy of creating interim licences for UWB applications with low potential to cause interference on a case-by-case basis until international standards and compatibility studies are more mature.

7 NEXT STEPS

The Ministry intends to:

- Follow up this technical discussion paper with two seminars, in Auckland and Wellington, to be held in April 2005.
- Participate in ITU-R TG 1/8 meetings to be held in May and October 2005 to monitor and influence regulatory and technical developments.
- Report to the Minister of Communications on the industry submissions and TG 1/8 decisions.
- Continue to closely monitor and influence, where possible, international regulatory, technical and commercial developments on UWB.
- Publish the outcomes of the consultation process and future steps for industry.
- Draw information from international literature and engineering studies and commission some longer-term work on measuring the spectrum noise floor, in conjunction with universities or research institutes

8 SUBMISSION INFORMATION

If you wish to make a submission on the matters raised in this engineering discussion paper, please provide your comments by **Friday, 8 May 2005** to:

UWB Comments
Radio Spectrum Policy and Planning
Resources and Networks Branch
Ministry of Economic Development
PO Box 1473
WELLINGTON.

Fax (04) 4990969
Email: radiospectrum@med.govt.nz

Should you have any questions, please contact:

Chris Perera Ph (04) 462 4279 or
Dave Kershaw Ph (04) 474 2186

Please note:

The content of any submissions provided to the Ministry may be subject to release under the **Official Information Act 1982**. Please advise if you have any objection to the release of any information contained in a submission, and in particular, which part(s) you consider should be withheld, together with the reason(s) for withholding the information. The Ministry will take into account all such objections when responding to requests under the Official Information Act 1982.

The Privacy Act 1993 establishes certain principles with respect to the collection, use, and disclosure of information about individuals by various agencies including the Ministry. It governs access by individuals to information about themselves held by agencies. Any personal information you supply to the Ministry in the course of making a submission will be used by the Ministry only in conjunction with the matters covered by this document. Please clearly indicate in your submission if you do not wish your name to be included in any summary of submissions that the Ministry may publish.

9 APPENDICES

Appendix A - Summary of Issues

Ultra Wide Band Technology (refer Section 2)

Issue 2.a

The Ministry invites comments on the adequacy of the definitions used by the Ministry for UWB technology in this discussion paper and any alternative definitions the industry could propose.

Issue 2.b

The Ministry invites comments on the potential benefits and risks associated with the introduction of applications using UWB technology.

UWB Applications (refer Section 3)

Issue 3.a

The Ministry invites comments on the future demand for UWB imaging, vehicular radar and wireless communication system applications in New Zealand, along with comments on any sharing issues. The Ministry also invites views on the existing and planned receive-only Radio Astronomy use in the 23.6 - 24.0 GHz band in New Zealand.

Overseas Regulatory Developments (refer Section 4)

Issue 4.a

The Ministry invites comments on the FCC proposals for different UWB applications and their applicability to New Zealand.

Comments are also invited on the UK proposal for UWB indoor communication devices in comparison to the FCC limits and the ETSI limits.

Further, comments are invited on the EU proposal on vehicular radar and the applicability of the proposed parameters to New Zealand.

Options available for New Zealand (refer Section 5)

Issue 5.a

The Ministry invites comments from industry on the extent to which UWB should be allowed in New Zealand and preferred timings.

Issue 5.b

The Ministry invites comments on industry's preferred options for licensing UWB and timings.

Issue 5.c

The Ministry invites comments on the strategy of creating interim licences for UWB applications with low potential to cause interference on a case-by-case basis, until international standards and compatibility studies are more mature.

Appendix B – 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

Frequency (MHz)	e.i.r.p
960 -1610	-65.3 dBm/MHz
1610 -1990	-53.3 dBm/MHz
Above 1990	-51.3 dBm/MHz

Table 3 –Summary of Emission Limits for Imaging systems below 960 MHz

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

Table 4 –Summary of Emission Limits for Imaging systems above 1990 MHz

Frequency (MHz)	e.i.r.p
960 -1610	-63.3 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 5 –Summary of Emission Limits for Imaging systems above 3100 MHz

Frequency (MHz)	e.i.r.p
960 -1610	-75.3 dBm/MHz
1610 -22,000	-61.3 dBm/MHz
22,000-29,000	-41.3 dBm/MHz
29,000-31,000	-51.3 dBm/MHz
Above 31,000	-61.3 dBm/MHz

Table 6 –Summary of Emission Limits for Vehicular radar systems

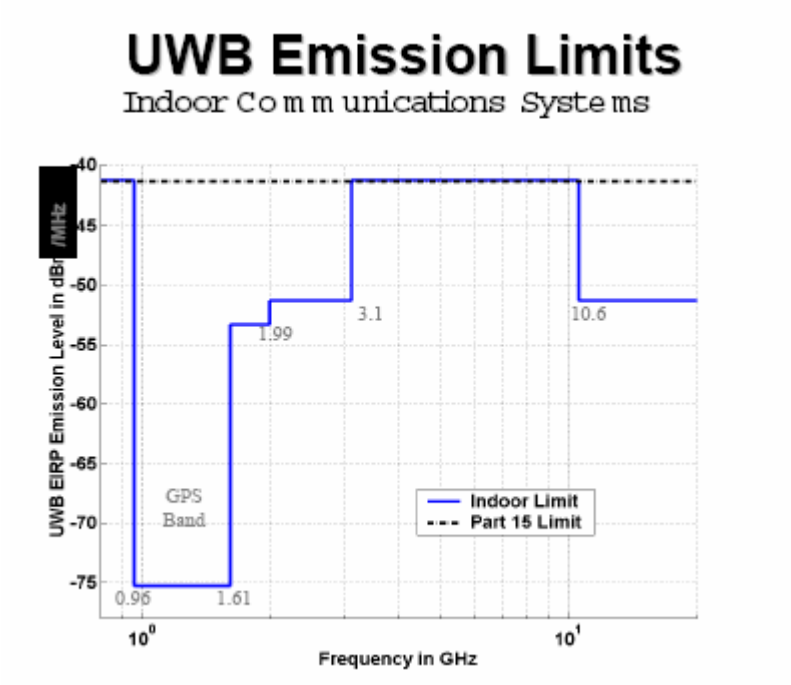

Figure 2: FCC Emission Limits for Indoor Communication systems

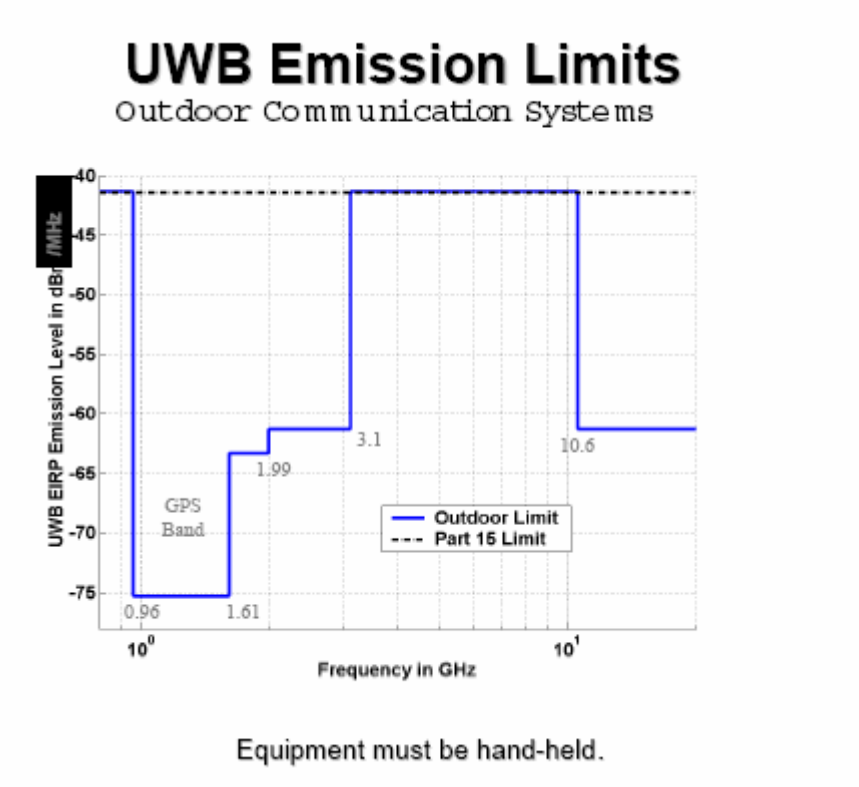

Figure 3: FCC Emission Limits for Outdoor hand-held Communication systems

Appendix C – Proposed Emission Limits – Europe

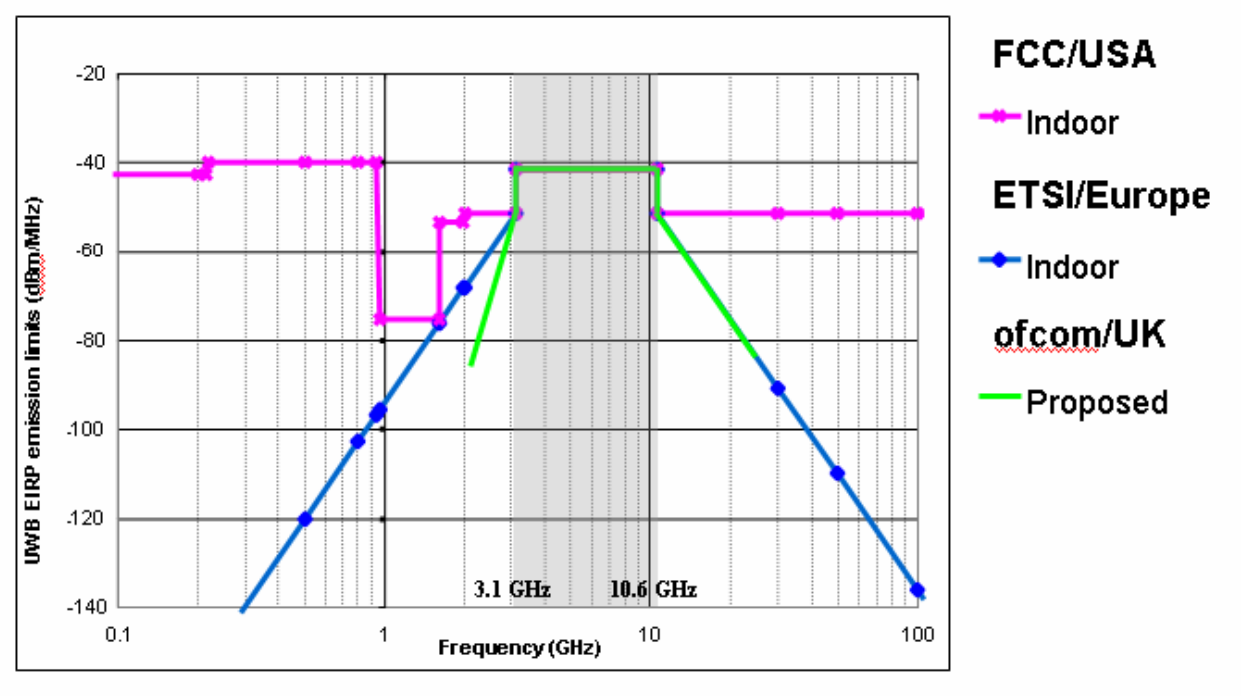

Figure 4: Proposed Emission Limits in Europe

Source: IDA / AWF

Appendix D – Proposed Emission Limits - Asia

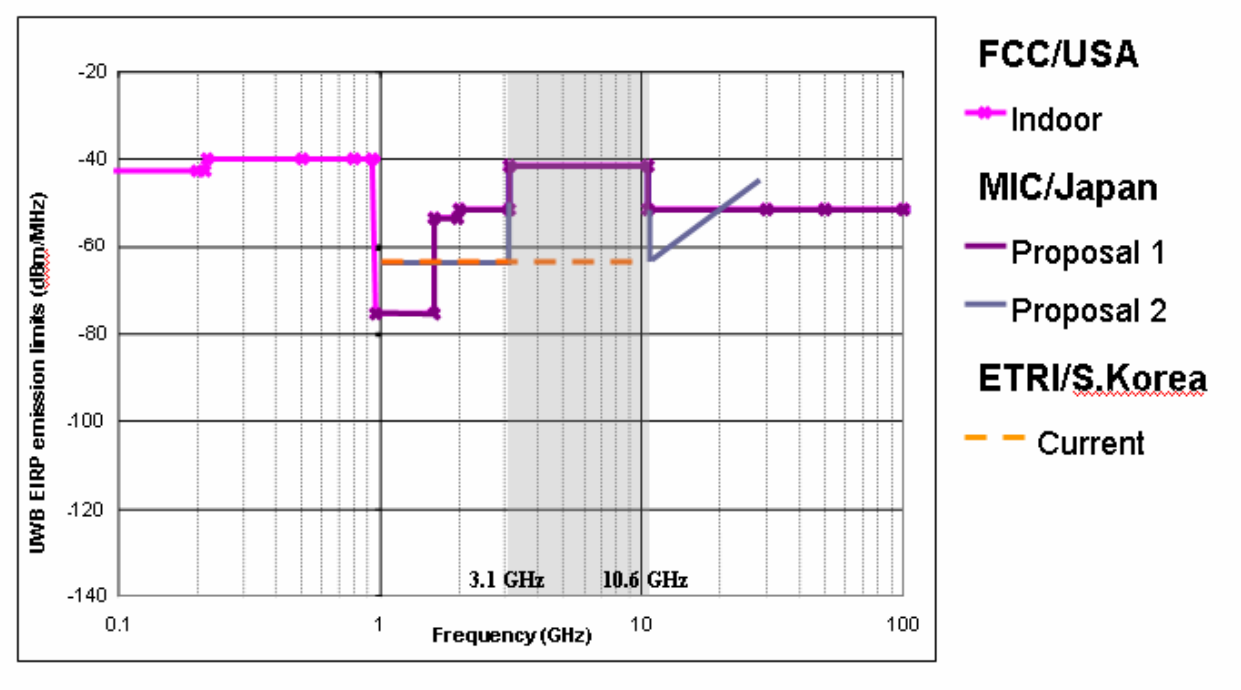

Figure 5: Proposed Emission Limits in Asia

Source: IDA / AWF

Appendix E – Trial Emission Limits – Singapore

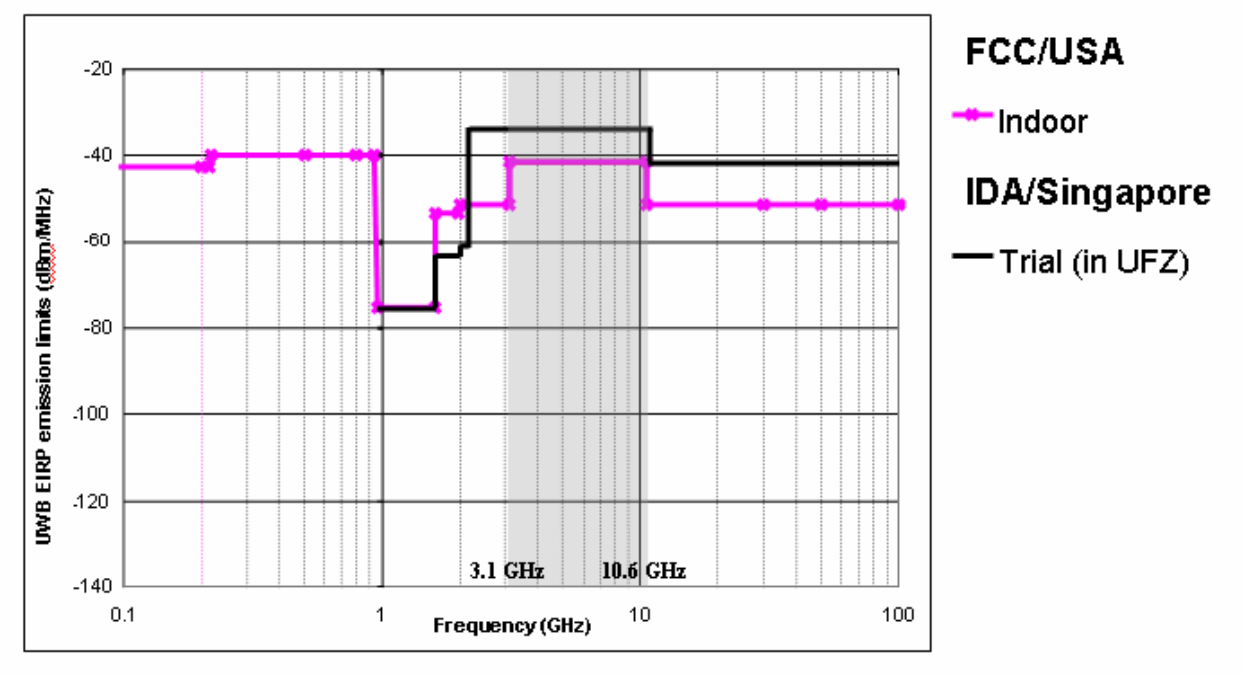

Figure 6: Trial Emission Limits in Singapore

Source: IDA / AWF