



Australian Government
**Australian Communications
and Media Authority**

Australia's regulator for broadcasting, the internet, radiocommunications and telecommunications

www.acma.gov.au

Spectrum Licensing Technical Frameworks

Information Paper

April 2009

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List of abbreviations

Abbreviation	Explanation
ACMA	Australian Communications and Media Authority
AP	Accredited Persons
dB	Decibel
DBC	Device Boundary Criterion
dBi	Decibel isotropic
dBm	Decibel milliwatt
EIRP	Equivalent Isotropically Radiated Power
FDD	Frequency Division Duplex
HRP	Horizontally Radiated Power
IF	Intermediate Frequency
IIC	Interference Impact Certificate
LOP	Level Of Protection
MP	Maximum Power
RF	Radio Frequency
RP	Radiated Power
RRL	Register of Radiocommunications Licences
TDD	Time Division Duplex

1 Introduction

1.1 Spectrum Licences & Technical Frameworks

Spectrum licensing is one of three licensing options available under the regulatory arrangements implemented by the Australian Communications and Media Authority (ACMA) to manage the radiofrequency spectrum. Spectrum licences were introduced in the *Radiocommunications Act 1992* (the Act) and offer a technology-flexible, market-oriented approach to managing the radiofrequency spectrum.

Spectrum licences authorise the use of a parcel of spectrum space. Licensees are able to deploy transmitters or devices from any site within their spectrum space, as long as the operation of the device complies with the core conditions and technical framework applicable to the spectrum licensed band.

A technical framework is the collection of technical regulatory conditions that apply to the use of devices within spectrum licensed bands. The Act specifies the mandatory and optional statutory requirements for a spectrum licence technical framework. Under sections 66, 145 and 262 of the Act, ACMA specifies the following:

- a defined frequency and area;
- specified out of band limits and out of area limits;
- a written determination made under section 145 of the Act setting out what is considered to be an unacceptable level of interference; and
- Advisory guidelines, made under section 262 of the Act, in relation to any aspect of radiocommunication or radio emissions including interference, for example.

Typically, all of the above elements are included in spectrum licensing technical frameworks¹. ACMA has applied the same underlying principles regarding space-centric spectrum management² for every technical framework.

1.2 Purpose

The purpose of this information paper is to provide information to stakeholders about Australian spectrum licensing arrangements and the technical frameworks that support them. It is intended that the information paper be used as a resource for both ACMA and its

¹ The one exception is the 20/30 GHz Defence spectrum licence.

² Australia has used a “space-centric” methodology that allows a spectrum licensee to conduct interference coordination to an area instead of to a specific device.

stakeholders in industry and government to share information and provoke discussion on spectrum licensing arrangements generally.

1.3 Review of Spectrum Licensing Technical Frameworks

This information paper has been released in conjunction with the consultation paper *Spectrum Licensing Technical Frameworks Review Discussion Paper*³. ACMA anticipates that the associated release of the information paper alongside the consultation paper will provide prospective respondents with further information and understanding. The purpose of the consultation paper is to stimulate discussion and seek views from stakeholders on how spectrum licensing technical frameworks may be improved into the future. The purpose of the review of spectrum licensing technical frameworks is to:

- improve the efficiency and effectiveness of technical frameworks for future spectrum allocations;
- ensure that technical frameworks are clear and easily understood by industry;
- ensure a consistent approach to technical frameworks for different spectrum licensed bands is employed;
- ensure future technical frameworks meet industry requirements;
- ensure future technical frameworks can accommodate new technology developments and interference methods; and
- ensure Australia is employing international best practice principles when creating technical frameworks.

1.4 Currency of this paper

Despite the release of this information paper with the consultation paper, the information paper is a stand alone document that is intended to be updated and provide further information on the development of spectrum licence technical frameworks over time. ACMA will ensure the paper is kept up to date.

Further information on spectrum licensing arrangements is available on the ACMA website at www.acma.gov.au or may be obtained by contacting ACMA using the details provided below.

Telephone: 1300 850 115

E-mail: LAIS@acma.gov.au

³ Available from the ACMA website. http://www.acma.gov.au/WEB/STANDARD/pc=PC_311701

2 Spectrum Licensing Overview

2.1 Legislative basis for Australian spectrum management

The *Australian Communications and Media Authority Act 2005* sets out the spectrum management functions of ACMA, including:

- Management of the radiofrequency spectrum in accordance with the Act; and
- To advise and assist the radiocommunications community.

ACMA undertakes its responsibility to manage the radiofrequency spectrum in accordance with the objects set out in section 3 of the Act. The objects are provided in the table below.

Section 3 – Object of the Act

- (a) maximise, by ensuring the efficient allocation and use of the spectrum, the overall public benefit derived from using the radiofrequency spectrum;
- (b) make adequate provision of the spectrum:
 - (i) for use by agencies involved in the defence or national security of Australia, law enforcement or the provision of emergency services; and
 - (ii) for use by other public or community services;
- (c) provide a responsive and flexible approach to meeting the needs of users of the spectrum;
- (d) encourage the use of efficient radiocommunication technologies so that a wide range of services of an adequate quality can be provided;
- (e) provide an efficient, equitable and transparent system of charging for the use of spectrum, taking account of the value of both commercial and non-commercial use of spectrum;
- (f) support the communications policy objectives of the Commonwealth Government;
- (g) provide a regulatory environment that maximises opportunities for the Australian communications industry in domestic and international markets;
- (h) promote Australia's interests concerning international agreements, treaties and conventions relating to radiocommunications or the radiofrequency spectrum.

ACMA also has related spectrum management obligations under the *Broadcasting Services Act 1992*, which guide the use of spectrum in the broadcasting services bands⁴. ACMA will

⁴ The broadcasting services bands are those parts of the radiofrequency spectrum that, under s.31 of the Radiocommunications Act, are designated as being primarily for broadcasting purposes.

continue to be guided by the objects set out in the Broadcasting Services Act when making decisions on matters that fall under that Act.

ACMA must consider government policies in the performance of its functions. The Minister may also give written directions to ACMA about the performance of its functions under the Radiocommunications Act.

Radiocommunications licences are also subject to provisions in the *Trade Practices Act 1974*, which prohibit acquisitions that result in a substantial lessening of competition.

2.2 Spectrum management

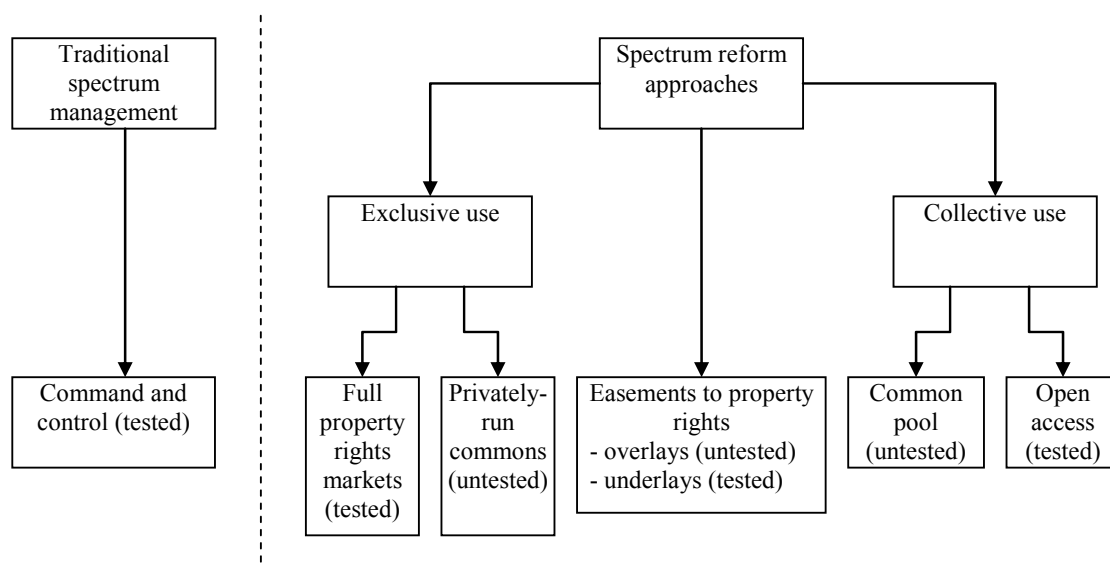
ACMA recognises that its planning and licensing decisions may affect the shape of the market and the value of spectrum to different parties. An essential and challenging element of spectrum management is recognising and meeting the needs of existing spectrum users, while at the same time, supporting the dynamic growth and changing uses of spectrum.

In order to meet this challenge in a consistent and effective way, ACMA proposes to adopt certain principles of good regulatory process and apply an agreed set of spectrum management principles.

In 2007, ACMA commissioned *The Economics of Spectrum Management – a review*⁵. The paper examines different approaches to spectrum management used by international spectrum regulators – command and control, exclusive rights, easements and commons.

Figure 2.2 illustrates standard (or mainstream) and intermediate models for spectrum management. It identifies the regulatory models that are currently being used internationally, as well as those approaches that have been identified but not yet implemented.

Figure 2.2 – Spectrum management: standard and intermediate models



⁵ B. Freyans, School of Economics, Australian National University, 2007, *The Economics of Spectrum Management: A Review*, http://www.acma.gov.au/WEB/STANDARD/pc=PC_311025

In general terms, the apparatus licensing regime is related to the command and control approach in figure 2.2, class licensing is related to the collective use/open access model, and spectrum licensing is related to exclusive use/full property rights markets.

2.3 Radiocommunications licensing in Australia

ACMA is responsible for managing the radiofrequency spectrum in Australia in accordance with the *Radiocommunications Act 1992* (the Act). Sections 46 and 47 of the Act provide that radiocommunications devices must only be operated if authorised by a spectrum, apparatus or class licence.⁶

Class licences are open, standing authorities that allow anyone to operate particular radiocommunications equipment provided that the operation of the device is in keeping with the conditions of the licence.

Apparatus licences are issued on an individual basis and authorise the operation of a specific device or service. This approach, also known as a device-centric approach⁷, uses different licence categories to specify the operational conditions for various types of services, for example broadcast, fixed or land mobile.

Spectrum licensing offers a technology flexible, market-oriented approach to managing the radio frequency spectrum. A spectrum licence authorises the use of spectrum space in relation to both a frequency band and a geographical area. This approach, termed ‘space-centric’, allows licensees to deploy any device from any site within the specified spectrum space, provided that the device is compatible with the core conditions of the licence and the technical framework for the band.⁸

One advantage of a space-centric approach is that services can be deployed in a more flexible manner, whereas under the apparatus licence scheme, licensees are constrained by the licence to deploy a specified type of service. Other features unique to the spectrum licensing regime include the following:

- Flexibility to customise the specific bandwidth is ensured which enables greater spectrum efficiency. Therefore, licensees are able to purchase or sell units of spectrum space to tailor the spectrum to their needs.
- Flexibility to determine which technology to deploy under the licence conditions.
- Licensees are able to acquire the same parcel of spectrum over a large geographical area, up to nation wide coverage.
- Increased certainty though pre-defined licence terms of up to 15 years.

The space-centric approach adopted in spectrum licensing arrangements raises different interference issues than those associated with other licensing regimes. These issues need to be managed under the spectrum licence in order to effectively coordinate with other users of

⁶ More information on the three licensing type can be found on the ACMA website, see - http://www.acma.gov.au/WEB/STANDARD/pc=PC_481

⁷ In a device-centric approach, the licensing conditions specify the device parameters, such as the type of service and operating location

⁸ Further information on spectrum licensing can be found on the ACMA website, see - http://www.acma.gov.au/WEB/STANDARD/pc=PC_300172

spectrum. ACMA manages these potential interference issues defining geographic and frequency boundaries that apply to spectrum licences. These boundaries are established in order to provide certainty for spectrum licensees and other licensees operating in or adjacent to spectrum licensed areas or frequency bands. The geographic and frequency boundaries are specified as core conditions in the technical framework for the spectrum licensed frequency band.

2.4 Spectrum licensing

Spectrum licensing is one of three licensing arrangements authorising the operation of radiocommunications devices. Spectrum licensing has been applied to frequency bands for which there is likely to be high demand, or bands which are considered likely to be of high value.

Prior to the creation of a technical framework, the identified spectrum band is designated for allocation by spectrum licence. This is a statutory process which involves both ACMA and the Minister for Broadband, Communications and the Digital Economy.

The Act provides two processes by which a spectrum band can be made available for spectrum licensing:

- Section 36 – Designation of parts of the spectrum for spectrum licences. This section provides that the Minister may, after consultation with ACMA, give ACMA a written notice designating a specified part of the spectrum to be allocated by issuing spectrum licences. ACMA may make recommendations to the Minister in relation to the designation notice before it is issued; however ACMA must first make its draft recommendations available for public consultation. Once ACMA receives the designation notice from the Minister, the technical framework for the specified spectrum band and area can be created.
- Section 153 – Re-allocation of encumbered spectrum. This part provides for the Minister to issue a spectrum re-allocation declaration after a recommendation has been submitted from ACMA. ACMA must seek public comment on its recommendation prior to submitting it to the Minister. In particular, ACMA will seek comment from each potentially-affected apparatus licensee. The Minister is required to give a copy of the final re-allocation declaration to ACMA, after which ACMA makes the declaration publicly available. After ACMA releases the re-allocation declaration the technical framework for the specified spectrum band and area can be created.

Spectrum licences are usually allocated by market-based mechanisms such as auctions. They are issued for a fixed term of up to 15 years, and may be sub-divided, combined and traded⁹.

Technical conditions on spectrum licences are intended to promote technology flexibility. Spectrum licences permit the deployment of any device from any site within the spectrum licensed space, subject to the conditions of the licence and relevant technical specifications.

⁹ Further information about spectrum licensing is available from http://www.acma.gov.au/WEB/STANDARD/pc=PC_300171

With spectrum licence expiry and other issues appearing on the policy horizon, DBCDE and ACMA are considering the policy and licensing options available in these bands. The first spectrum licences are due to expire in 2012. The policy options available include:

- Re-issuing the spectrum licence to the person whom it was previously issued; or
- Issuing a spectrum licence to new persons; or
- Converting the spectrum licensed band to either an apparatus or class licensed band.

2.5 Purpose of technical frameworks

The primary purpose of a spectrum licensing technical framework is to specify the minimum technical requirements for the operation of devices under a spectrum licence aimed at managing interference between users. In other words, it is the set of technical licence conditions specifying the right to deploy and operate radiocommunications devices within a defined geographic area and frequency band.

Although technical frameworks are intended to be technology flexible, they are generally designed to cater for a technology that is likely to be deployed in the band. Consequently, the technical framework needs to be flexible and robust for it to continue to be effective across the term of the spectrum licence.

2.5.1 Planning considerations

The technical licence conditions of a technical framework need to be carefully considered in order to determine how the introduction of new services will be coordinated with each other, and how their deployment will affect existing spectrum users. The following issues need to be considered in the development of any technical framework:

- The inclusion of mechanisms to ensure the spectrum licensed band is technology flexible;
- packaging spectrum for allocation with reference to technology and competition considerations;
- techniques to manage interference across frequency and geographic boundaries;
- techniques to manage interference across spectrum, apparatus and/or class licence boundaries; and
- techniques to manage the potential for interference between existing services and services authorised to operate under spectrum licences.

ACMA specifies technical licence conditions in the form of legislative instruments including:

- the core conditions specified in the spectrum licence, in accordance with section 66 of the Act;
- in a determination made under section 145 of the Act setting out what is considered to be unacceptable levels of interference; and
- in Advisory Guidelines made under section 262 of the Act that provide further information to spectrum licensees about interference management techniques.

Further information on these elements are provided in section 2.6 below.

The level of acceptable interference between devices needs to be carefully calculated in order to maintain spectrum efficiency without compromising device functionality. For example, if the level of acceptable interference is set too low, large amounts of spectrum space could remain unused as large buffer zones would be required to protect against interference. Conversely, if the acceptable level of interference is set too high, functionality of devices deployed in the spectrum space could be affected due to elevated levels of interference experienced. These factors need to be evaluated and modelled to determine the deployment rights that will maintain the optimal balance of functionality and efficiency.

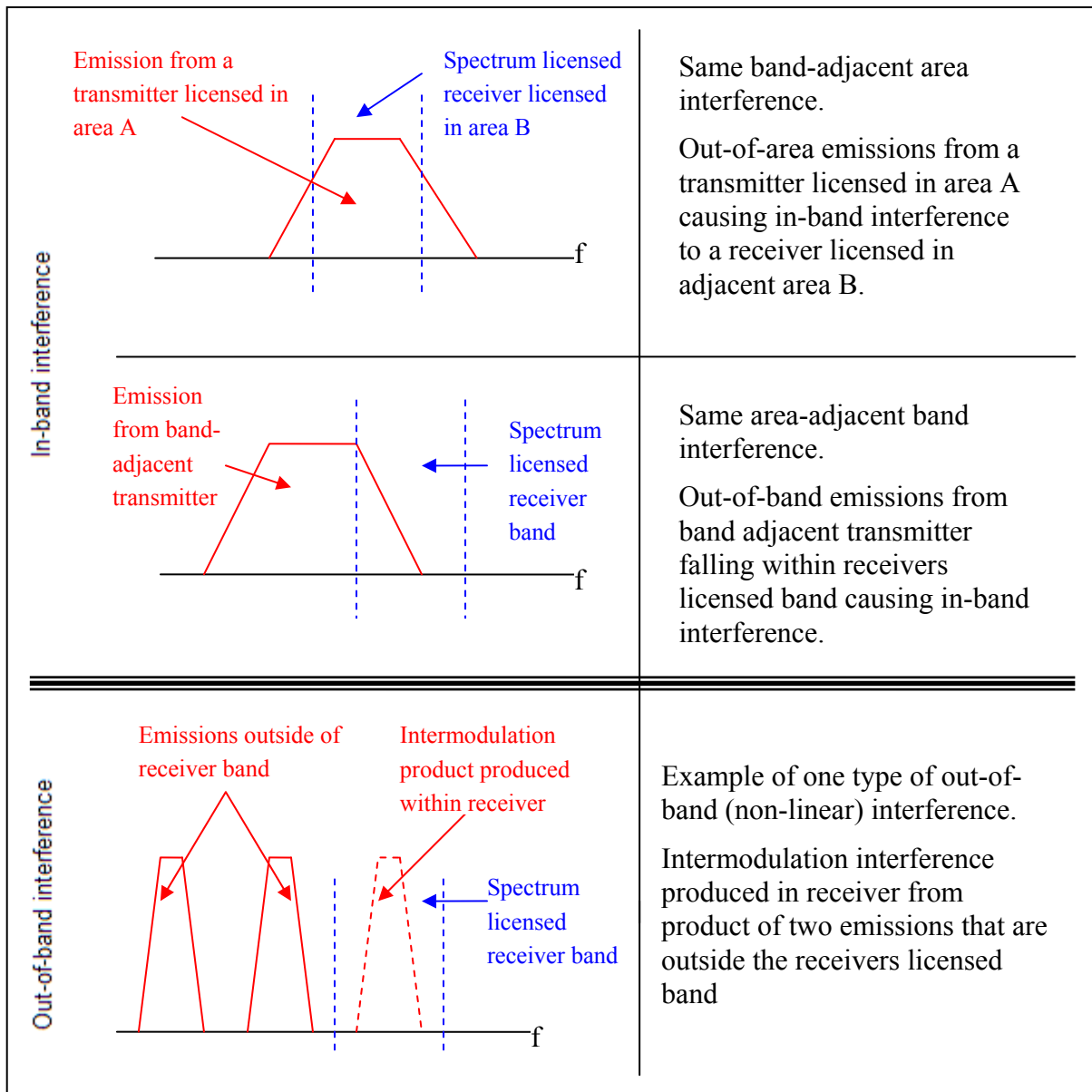
2.5.2 Interference scenarios

Technical licence conditions are intended to minimise the costs of interference management associated with use of the radiofrequency spectrum. There are two categories of interference that need to be managed to ensure the effective and efficient use of spectrum, including:

- In-band interference: Emissions within the receiver licensed bandwidth. The two sub-categories for in-band interference are:
 - Same band-adjacent area - interference caused by emissions from an area adjacent licensee's transmitter which falls within the affected receivers licensed band, otherwise known as out-of-area emissions;
 - Same area-adjacent band - interference caused by emissions from a transmitter licensed within the same geographical area but operating under a frequency adjacent licence, otherwise known as out-of-band emissions¹⁰.
- Out-of-band interference: Interference caused by emissions at frequencies well outside the receivers licensed band. The magnitude of this type of interference is dependent on the non-linear properties of the receiver.

¹⁰ In some rare cases it may be possible to also have this type of interference caused by emissions from a transmitter operating under a frequency adjacent licence and located in an adjacent area.

Figure 2.1 Interference scenarios managed by technical frameworks



2.6 Components of technical frameworks

The technical framework consists of three interlocking regulatory elements that define the transmission rights of spectrum licensed devices in order to manage the interference scenarios described in section 2.5.2 above. These elements are:

- core conditions of the spectrum licence;
- a determination of unacceptable interference for the purpose of device registration; and
- radiocommunications advisory guidelines.

2.6.1 Core conditions

The core conditions of a spectrum licence are mandatory technical requirements that determine the overall technology flexibility of the licence. The core conditions of a spectrum licence are set out in section 66 of the Act. The core conditions include:

- the geographic area of operation;
- the frequency of operation;
- the permissible out of area emission limits; and
- the permissible out of band emission limits.

Section 66 of the Act also provides for the application of a further core condition. This condition, if applied, enables the specification of time periods during which operation is authorised under the licence.

This condition has not been applied to a spectrum licence to date.

Geographic area of operation

This core condition specifies the geographic area within which operation of radiocommunications devices are authorised under the spectrum licence. Once the Designation Notice or Re-allocation Declaration is in place, ACMA undertakes some analysis of the technical, commercial and economic environment to determine appropriate geographic areas for allocation.

A further consideration in the development of geographic areas for spectrum licences is the Spectrum Map Grid (SMG). The SMG breaks the Australian continent into various grids, or cells, of various sizes ranging from 3 degrees of arc, 1 degree of arc and 5 minutes of arc respectively. The size of the cells relate to the original methodology employed to develop the SMG.

The SMG was developed using census districts and therefore relates directly to the number of population within an area. As a result, the higher the population density the smaller the grid size on the SMG. Consequently, the grid size in metropolitan areas reflects 5 minutes of arc respectively. ACMA can vary the SMG to reflect cell sizes that represent the economies or communities that are likely to want to access or obtain spectrum. For example, ACMA recently amended the SMG for the allocation of the residual spectrum in the 2.3 GHz band.

Residual spectrum was available for allocation in areas of rural and remote Australia in the 2.3 GHz band. ACMA received interest in the spectrum from the mining and resources industry to deploy WiMAX services; however the mining industry were not keen on obtaining spectrum for a large geographic area. The mining industry wanted smaller geographic areas made available for allocation. As a result, ACMA amended the SMG by reducing the cell size in rural/remote Australia from 3 degrees of arc to 1 degree of arc respectively.

Generally, ACMA determines the geographic areas, or lots, to be made available for allocation after taking into account factors such as:

- The equipment available for the band and its technical specifications; or
- The location of existing services; or

- The economic characteristics of a community or geographic area; or
- Existing and forecast population densities for geographic areas.

Once these areas are determined, ACMA includes their geographic coordinates in the Spectrum Marketing Plan for the relevant frequency band. The geographic area is specified in the spectrum licence by coordinates. For example, a licence may specify the licensed area as below, with the South West corner coordinates in column 1 and the North East coordinates in column 2:

Column 1		Column 2	
° ' " South	° ' " West	° ' " North	° ' " East
43:35:00	148:00:00	42:20:00	146:45:00

Frequency band of operation

This core condition specifies the frequency band that devices are authorised to operate under the spectrum licence. This is specified using the upper and lower limits of the band. Some of the issues taken into account by ACMA in specifying the frequency of operation include:

- the minimum bandwidth likely services may require to operate efficiently;
- the operating characteristics of adjacent services; and
- the number of likely operators.

For example, a 2 GHz spectrum licence may specify the frequency limits as:

<i>Lower limit of frequency band</i>	<i>1.970 GHz</i>
<i>Upper limit of frequency band</i>	<i>1.980 GHz</i>

Permissible out of area emission limits

This core condition controls the level of emissions that fall outside the geographic area of the spectrum licence. In most cases this is expressed as a horizontal radiated power¹¹ limit that applies to all transmitters, no matter where they are located, within the spectrum licence area. For example, a 2 GHz band spectrum licence may specify the maximum horizontal power limit as 55 dBm per 30 KHz. This limit helps manage both in-band (same band-adjacent area) and out-of-band interference scenarios.

Permissible out of band emission limits

This core condition controls the amount of emissions across the frequency boundaries of licences and includes limits for spurious and non-spurious unwanted emissions.

- Non-spurious unwanted emissions are noise products that are associated with the transmission of information by the transmitter.

¹¹ Horizontal radiated power is the power limit radiated from an antenna in the horizontal plane. A full description can be found in the sample licence contained within the relevant Marketing Plan. Marketing Plans can be found within the relevant Technical Framework link, see http://www.acma.gov.au/WEB/STANDARD/pc=PC_1583

- Spurious emissions are noise products not associated with the transmission of information by the transmitter.

Out of band emissions limits are usually specified at particular offsets from the band edge of the spectrum licence, which is also referred to as emission masks. For example, in the frequency range 0 – 0.75 MHz from the licensed band edge, the maximum power from a transmitter may be specified as 12 dBm per 30 KHz.

2.6.2 Unacceptable levels of interference

Although the core conditions form the basis of a spectrum licence and provide mechanisms for interference management, they cannot, by themselves, enable efficient device deployment and spectrum usage without compromising receiver protection. Further conditions or constraints are imposed on devices operating under spectrum licences. These additional conditions are primarily controlled through the requirement in each spectrum licence for transmitters to be registered prior to use, unless they meet certain exemptions such as low powered transmitters or mobile devices.

Section 145 of the Act provides ACMA with the power to refuse to register a device that is deemed to cause unacceptable interference when operated. Furthermore, subsection 145(4) of the Act enables ACMA to determine by written instrument what those levels of unacceptable interference are. A determination relating to unacceptable interference has been implemented for each spectrum licensed band.

The definition of unacceptable levels of interference in the s145 determinations set out the circumstances under which device registration may be refused by ACMA. These circumstances include:

- if any part of the device boundary¹² falls outside the licensed geographical area; and
- if the operation of the transmitter will cause a breach of a core condition of the licence.

Devices may also be required to meet certain deployment constraints which are specified within the definition of unacceptable levels of interference. Deployment constraints, for example, may limit the operating heights of devices within specified bands¹³.

Licensees manage their levels of interference by controlling variables such as the transmitter's power and location, with respect to the distance from the licence area boundary, antenna height and surrounding terrain. These criteria and s145 determinations are discussed further in chapter 5.

2.6.3 Radiocommunications Advisory Guidelines

Further guidance on device deployment and coordination is provided in the Radiocommunications Advisory Guidelines made under section 262 of the Act. Radiocommunications Advisory Guidelines can refer to any aspect of radiocommunication or radio emissions. Generally, Radiocommunications Advisory Guidelines include

¹² The device boundary can be described as the boundary around a device where the emission level is below a specified level. Chapter 5.2 discusses the device boundary and calculation methods further.

¹³ For example, in the s145 unacceptable levels of interference determination for the 800 MHz band, a transmitter with an effective antenna height greater than 10 metres and operating in the 800 MHz Lower band (825 – 845 MHz) is taken to cause unacceptable interference.

provisions to assist interference assessments between spectrum licensed devices and services operating under apparatus or class licences¹⁴. For example, the guidelines may include a decreased power limit at frequencies close to the boundary of a spectrum licensed band in order to mitigate interference affecting the adjacent band service. Potentially affected adjacent band services are identified in the guidelines which enables licensees to make arrangements or assess the risk of interference between services.

It is important to note the contrasting roles between the Radiocommunications Advisory Guidelines and the s145 Unacceptable Levels of Interference Determinations. The Radiocommunications Advisory Guidelines provide assistance and advice for coordination with other services when and where such support is required. On the other hand, s145 determinations impose additional device deployment constraints. The Radiocommunications Advisory Guidelines are discussed further in chapter 6.

¹⁴ These can also be used to assess interference between different spectrum licensed services.

3 Creation of Technical Frameworks

3.1 Introduction

The process of developing a technical framework generally follows the steps outlined in figure 3.1 below. These processes are explained in detail throughout this chapter and in chapter 4.

Figure 3.1 Steps in developing a Technical Framework



ACMA typically seeks industry input in the development of technical frameworks through the creation of an industry working group.¹⁵ Prospective spectrum licensees are encouraged to participate in the development phase to help ensure that the technical framework will accommodate their technical requirements.

3.2 Determining the use of a spectrum band

3.2.1 Prior planning

Before making any decisions about the manner in which particular spectrum will be licensed, ACMA undertakes an information-gathering and assessment process to determine how spectrum can be allocated efficiently to maximise the overall public benefits derived from its use.

To make informed decisions about the most appropriate form for licensing for particular bands, ACMA generally uses a number of processes to obtain an understanding of the technical, economic and social environments governing users and services. The information-gathering and planning tools used include:

- **Spectrum Management Principles¹⁶** – The spectrum management principles are intended to guide ACMA’s management of the radiofrequency spectrum within its existing legislative responsibilities and government policy settings. The five principles are:
 1. Allocate spectrum to the highest value use or uses.
 2. Enable and encourage spectrum to move to its highest value use or uses.
 3. Use the least cost and least restrictive approach to achieving policy objectives.
 4. To the extent possible, promote both certainty and flexibility.
 5. Balance the cost of interference and the benefits of greater spectrum utilisation.
- **Environmental scan** – ACMA uses industry information gathered formally, through mechanisms such as public discussion papers, Spectrum Tune-Ups and other consultative fora; and informally via ongoing industry interaction. Particular drivers of spectrum demand are also examined allowing ACMA to monitor probable ‘pressure points’ on spectrum over the coming years.
- **Assess future spectrum needs** - ACMA assesses the current and anticipated future spectrum requirements of radiocommunications services by looking at the drivers in an Australian context and identifying the implementation and spectrum related implications for Australia. Using this information ACMA develops proposals to address these identified spectrum needs.
- **Develop indicative spectrum management work programs** – ACMA’s future spectrum management work program is set out in the *Five-year Spectrum Outlook*

¹⁵ Industry working groups are discussed further in section 3.3.

¹⁶ The spectrum management principles are currently in draft form and can be found in a consultation paper on the ACMA website, see - http://www.acma.gov.au/WEB/STANDARD/pc=PC_311103

(the Outlook). The Outlook contains ACMA's indicative spectrum management work programs for the next five years. The work programs contain spectrum management projects and tasks which have been extracted from the spectrum demand analysis in the Outlook. Each project has been attributed an indicative time frame for commencement and a priority rating.

- **Implementation** – the work programs identified in the Outlook are used as the basis for spectrum management work undertaken by ACMA. This is generally the stage at which ACMA will identify whether implementing spectrum licensing arrangements for a particular band could be appropriate. If this is the case, ACMA will undertake additional band specific consultation with industry and stakeholders to seek input on the proposed licensing and technical frameworks for the band.

3.3 Industry Consultation on Technical Frameworks

Generally, an industry working group is formed to contribute to the development of a technical framework for a spectrum licensed frequency band. Typically, members of the working group will include:

- representatives of radiocommunications equipment manufacturers, wholesalers and retailers;
- potential licensees;
- accredited persons;
- standards bodies; and
- members from ACMA.

ACMA staff chair the working group and are responsible for preparing discussion papers which are distributed to participants. This is typically done via email in the weeks prior to meetings to allow time for participants to prepare and put forward any suggested changes or comments during the meetings themselves.

The timing and duration of the working group process is dependent on various factors, such as the need to analyse complex technical issues raised during meetings. The industry working group process is considered complete once all technical considerations raised by the group have been addressed.

The types of issues that have been considered by industry working groups for the development of past technical frameworks include:

- *The likely radio technologies to be used in the band.*

The likely, or expected, radio technologies to be used in the band are used as a benchmark to establish the system model. The system model becomes the example technology that the likely emission characteristics will be modelled on in the development of licence core conditions. Although, spectrum licensing arrangements are intended to be as technology-flexible as possible, technical frameworks are developed to optimise the use of the technologies most likely to be deployed in the band.

- *The duplexing to be used in the band.*

Technologies will be assessed to determine the respective operational characteristics in either Frequency Division Duplex (FDD) or Time Division Duplex (TDD) modes. Core

conditions or deployment constraints may be tailored to enable operation of equipment in its particular duplexing mode without causing unacceptable interference to services in adjacent spectrum. For example, lower transmission power limits may be applied to lots allocated for TDD operation that are frequency adjacent to FDD base receive spectrum.

- *The appropriate propagation model.*

A propagation model will be developed to suit to the frequencies, likely services and geographic areas of the spectrum licence. The propagation model will be used to set the device boundary criteria which is included in the s145 Unacceptable Level of Interference determination applicable to the band.

- *The notional receiver performance benchmarks.*

These benchmarks aim to reduce the risk of receivers being affected by out of band interference. The benchmarks are based on the likely services to be used in the band. These benchmarks are critical to enable coordination with other licensees and the management of interference.

- *The compatibility requirements.*

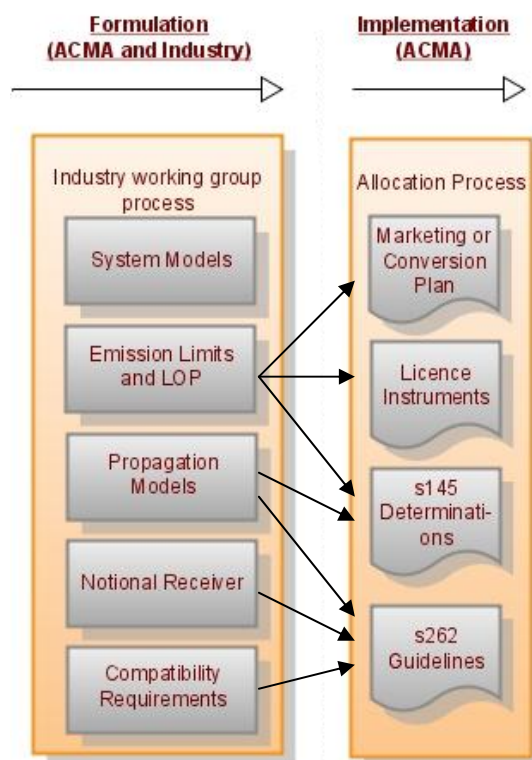
This is a specification of the parameters that a spectrum licensed transmitter must adhere to, with respect to adjacent apparatus, class and spectrum licensed receivers which may be at risk of interference. ACMA generally includes this information in a Radiocommunications Advisory Guideline made pursuant to section 262 of the Act. It should be noted that compatibility requirements are an aspect of technical frameworks that vary on a case by case basis, from one spectrum licensed band to another.

4 Implementing a Technical Framework

4.1 Legislative instruments

Once the technical parameters of the proposed technical framework have been determined in the industry working group process, the parameters are then set out in legislative instruments. The legislative instruments are made in accordance with the requirements set out in the Act and are discussed further below. Figure 4.1 demonstrates the links between particular outcomes of an industry working group process and the legislative instrument that the technical parameter will be set out in a technical framework.

Figure 4.1 Example of the relationship between outcomes of the industry working group process and formulation by ACMA through legislation



Following the industry working group process, ACMA drafts legislative instruments that provide the statutory basis for the technical framework once they are in force. The draft instruments will be made available for public consultation before being finalised and registered on the Federal Register of Legislative Instruments (the FRLI).

The legislative instruments which ACMA uses to implement a technical framework are:

- **Radiocommunications Spectrum Marketing Plan** (made in accordance with s39 or s39A of the Act) – A Marketing Plan is developed for each frequency band that is designated or declared for spectrum licensing. It includes the proposed method of allocating licences, a description of the lots available such as the frequency bandwidths available within specified geographic areas, or market areas. The Marketing Plan also sets out the core conditions and statutory conditions applicable to spectrum licences issued in accordance with the Marketing Plan.

Market areas are identified and specific to each Marketing Plan. This is because boundaries may vary between different spectrum licensed bands based on the socio-economic attributes of an area or population density, for example.

The Marketing Plan also contains a sample **spectrum licence**¹⁷ that is indicative of the licence that ACMA intends to issue to successful applicants. The licence lists the applicable core conditions (as mandated by s66 of the Act), as well as statutory conditions and other conditions included by ACMA.

- **Radiocommunications (Unacceptable Levels of Interference) Determination** (made under s145 of the Act) – The s145 Determination defines the level of emissions that are considered to cause unacceptable interference in the spectrum licensed frequency band. The s145 Determination also specifies the device boundary criterion to be applied for device certification and registration. This is discussed further in Chapter 5.
- **Radiocommunications Advisory Guidelines** (made under s262 of the Act) – The Advisory Guidelines provide strategies to mitigate interference between spectrum licensed and existing apparatus or class licensed services that:
 - may be area- or band-adjacent to a spectrum licensee; and
 - set out notional receiver performance specifications to be used for coordinating against spectrum-licensed receivers. This information is intended for use by apparatus licensees and spectrum licensees who may need to coordinate with registered spectrum-licensed receivers.

4.2 Ongoing Use of the Technical Framework

Following allocation of licences, any devices operated under a spectrum licence must function in accordance with the rules of the technical framework, as set out in the applicable legislative instruments.

¹⁷ A sample spectrum licence is initially prepared and made public as an attachment to the marketing plan. Individual licences are issued after allocation.

Licensees, often in conjunction with an Accredited Person¹⁸ (AP), undertake three major tasks that are dictated by the technical framework applicable to the band.

(1) Transmitter Registration - in accordance with the s145 Determination

- Licensees are required to register transmitters with ACMA using device boundary criterion as specified in the s145 Determination, or via the alternative certification options available in accordance with the *Radiocommunications Advisory Guidelines (Register of Devices under Spectrum Licences without an Interference Impact Certificate) 1998*¹⁹.
- Licensees are required to provide updated information for inclusion in ACMA's Register of Radiocommunication Licences (RRL) detailing any changes to device operating parameters.

(2) Receiver Registration - in accordance with the s262 guidelines

- Licensees can elect to register receivers on the RRL in order to claim protection from future installations of transmitters by an adjacent licensee.

(3) Coordination - in accordance with the s262 guidelines

- Licensees can use the coordination specifications in the guidelines to help ensure that their network is able to operate effectively without causing unacceptable interference to, or suffering from emissions from, area- or band-adjacent licensees.

¹⁸ ACMA provides accreditation to members of industry with suitable radiocommunications experience and skills, who are able to perform frequency assignment tasks for apparatus licensing, and device certification and registration tasks for spectrum licensees. For more information see -

http://www.acma.gov.au/WEB/STANDARD/pc=PC_500

¹⁹ See -

[http://www.comlaw.gov.au/ComLaw/Legislation/LegislativeInstrument1.nsf/0/C909B5EAB775BFD3CA256FD4002A4C6C/\\$file/agregofdevices98.pdf](http://www.comlaw.gov.au/ComLaw/Legislation/LegislativeInstrument1.nsf/0/C909B5EAB775BFD3CA256FD4002A4C6C/$file/agregofdevices98.pdf)

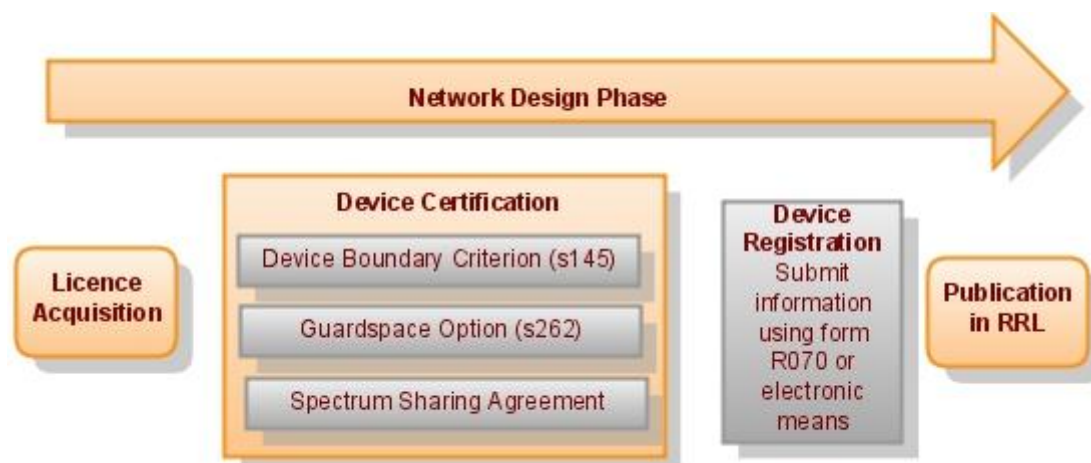
5 Interference Management

5.1 Device Certification and Registration

Spectrum licensees are required to demonstrate compliance with their licence conditions through the mandatory certification and registration of transmitters. Certification provides a means to verify that a spectrum-licensed device does not cause unacceptable interference, either outside its geographic area or outside its allocated bandwidth.

Licensees are able to register their devices during their network design stage as transmitter locations and operating parameters are being planned. Registration is also required for any subsequent devices installed as part of network expansion or optimisation. An overview of the device registration requirements is depicted in Figure 5.1 below. A flowchart providing an overview of the certification and registration process can be found in [Appendix 1](#).

Figure 5.1 Device Certification and Registration Overview



The three existing certification options identified in Table 5.1, including the use of device boundary criterion, guard space or spectrum sharing agreements, are intended to provide flexibility for spectrum licensees.

For legal certainty, the methodology that is devised in the industry working group process is included and set out in the s145 Determination applicable to the band. This is known as the *Device Boundary Criterion* option and is explained further in Section 5.2. In addition to the device boundary criterion, each technical framework provides the option of using either the

Guard space Option, or a Spectrum Sharing Agreement²⁰ with adjacent or affected licensees. These options are provided as a further mechanism to ensure unacceptable interference is unlikely to occur. The guard space and spectrum sharing agreement options are described further in Section 5.2 and 5.3 respectively.

Table 5.1 Device Registration Options for Spectrum Licensing

Interference Type	Device Certification Option		
	Default (s145)	Guardspace Option	Agreement Option
Linear in-band area-adjacent interference	Out-of-area core conditions AND Device Boundary Criterion	Guardspace (area isolation from geographic boundary)	Spectrum Sharing Agreement (for out of area emissions)
Linear adjacent-band same area interference	Out-of-band core conditions	Guardspace (frequency isolation from band edge of licence)	Spectrum Sharing Agreement (for out of band emissions) ²¹
Non-linear out-of-band same area interference²²	Non-linear interference managed by: <ul style="list-style-type: none"> • Core conditions capping maximum in-band and out-of-band EIRP • Notional receiver benchmarks to limit impact of non-linear interference on spectrum-licensed receivers • Compatibility Requirements as detailed in the S262 guidelines. • Receiver registration. 		

5.1.1 The Register of Radiocommunications Licences (RRL)

Spectrum licensees provide technical information about each certified transmitter to ACMA for inclusion in the Register of Radiocommunications Licences (RRL). The RRL is available for on the ACMA website. Registration of transmitters or devices authorised to operate under a spectrum licence is a requirement under Part 3.5 of the Act.

The RRL contains information on:

- licences - spectrum, apparatus and class licence images
- licensees - spectrum and apparatus licensees
- devices - transmitters and receivers, and antennas used for each
- sites - geographic information on sites where devices are installed

The RRL is a tool that is used extensively by ACMA, licensees and other radiocommunications users. It aids the critical tasks of device coordination and interference management.

²⁰ Note that the Spectrum Sharing Agreement option can also be referred to as the 'external guardspace' option.

²¹ Core condition agreements must be made in accordance with the specifications of the Marketing Plan applicable to the specific spectrum licensed band.

²² Non-linear out of band interference management is discussed further in chapter 6.

5.1.2 The role of Accredited Persons

Section 263 of the Act provides for ACMA to accredit persons to perform certain activities related to the use of the radiofrequency spectrum. Such activities include frequency coordination and emission level management. ACMA currently accredits persons to issue two kinds of certificates:

- frequency assignment certificates (FACs) under section 100(4A) of the Act, relating to the operation of radiocommunications transmitters and receivers covered under apparatus licensing arrangements; and
- interference impact certificates (IICs) under section 145(3) of the Act, relating to the operation of radiocommunications transmitters in spectrum subject to spectrum licensing.

By issuing an IIC, the accredited person is certifying that significant levels of emission radiated from a device operating at a particular site, on a given carrier frequency, and within specific technical parameters, are contained within the spectrum licence under which it operates and are contained in a manner that is in accordance with the design of the technical framework established for that band release.

When issuing an IIC, an accredited person must ensure that a device meets the requirements of the s.145 Determination relevant to the band in question. The validity of an IIC depends entirely on compliance with the Determination. Where an IIC cannot be issued, because a proposed device does not meet the requirements of the relevant determination, it may still be possible to register the device, if the licensee provides appropriate guard space and/or can obtain a spectrum sharing agreement with all potentially affected licensees.

For the purposes of registering a device without an IIC, an accredited person may be required to provide proof about whether all licensees whose services may be affected by the operation of a specified device have agreed that the device may be operated in that way. Devices may also be registered without an IIC if an accredited person provides ACMA with advice that sufficient guard space will be maintained for the management of interference caused by the device within the meaning of the [Radiocommunications Advisory Guidelines \(Registration of Devices under Spectrum Licences without an Interference Impact Certificate\) 1998](#).

In addition to the s.145 Determinations, Advisory Guidelines are issued by ACMA under section 262 of the Act. The Advisory Guidelines usually provide a compatibility requirement for specific devices. The Advisory Guidelines do not usually define a procedure for achieving the compatibility criteria. Advisory Guidelines do not need to be taken into account when issuing an IIC; however, it is strongly recommended that they be considered, as the guidelines may be expected to form the basis for any interference settlement undertaken by ACMA.

Please note that at time of writing ACMA is reviewing its spectrum management systems, including processes for submission of spectrum licence device registrations. For up to date information on aspects of the RRL, interested persons should consult the ACMA website²³.

²³ See – www.acma.gov.au

5.1.3 Exemptions from device registration

For each spectrum licensed band, there are types of transmitters for which device registration requirements do not apply, as outlined in the relevant Marketing Plan. The most common exemption is provided to mobile transmitters such as user devices, and is specified in terms of a maximum radiated true mean power level. For example, in the 2 GHz spectrum licensed band, the exemption applies to mobile transmitters with ‘a maximum radiated true mean power of 24.5 dBm or less’²⁴.

Some low power fixed transmitters, such as indoor or pico-cell²⁵ transmitters may also meet the requirements for this exemption. Detailed information on the exact nature of transmitter registration exemptions is detailed in the respective Marketing Plans for each spectrum licensed band.

5.1.4 Groups of Transmitters

ACMA also provides options for simplifying the registration of transmitters that are co-located and operate with the same parameters. If two or more transmitters are operated for the purpose of communicating with the same receiver or same group of receivers and they have identical emission characteristics, those transmitters may be treated as a group in order to simplify the registration process. A transmitter may belong to more than one group.

Groups are defined to help minimise the work associated with the registration process of similar transmitters. A group of devices may have location details consisting of a centre and an associated effective radius that can take into account the distribution of subscriber transmitters.

More information on groups of transmitters can be found in the s145 determination for the respective spectrum licensed band.

5.1.5 Other options for device registration/spectrum usage

The technical framework also provides flexibility when dealing with interference between apparatus and spectrum licensed devices. ACMA provides licensees with the ability to negotiate with other spectrum licence holders and come to an agreement on varying the core conditions of a spectrum licence that may resolve interference or allow operation of a device or devices.

For example, a licensee may wish to operate devices that exceed the maximum radiated power level stated in the out of area core condition of their licence. To enable this deployment, the licensee must establish a core condition agreement with all licensees that may be affected by this increased radiated power level. More information on core condition agreements can be found on the ACMA website²⁶.

²⁴ See s 2.17(4), Radiocommunications Spectrum Marketing Plan (2 GHz Band) 2000 -

http://www.acma.gov.au/webwr/aca_home/legislation/radcomm/acts/radcom/2band_2000.pdf

²⁵ Pico-cells typically cover small in-door areas such as offices and underground car parks, and have a radius of less than 50 meters.

²⁶ http://www.acma.gov.au/WEB/STANDARD/pc=PC_2871

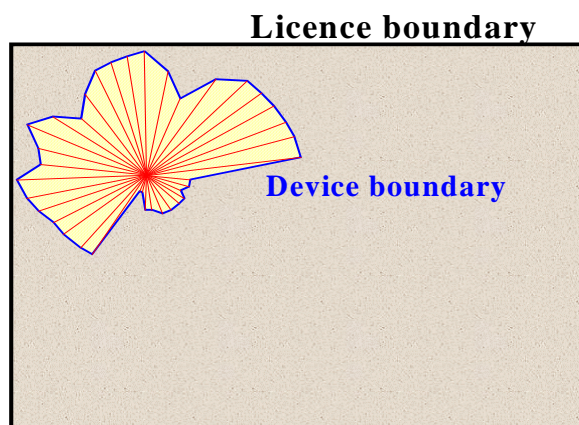
5.2 Device Boundary Criteria

5.2.1 Overview

Under a spectrum licensing technical framework, in band interference caused by out of area emissions is primarily managed using what is termed a device boundary criterion²⁷. The device boundary is the distance along a radial from the device that is required to ensure that the emission levels from the device are below the level of protection which has been defined for a spectrum licensed receiver in the band. Figure 5.2 shows an example of a device polygon drawn by connecting the end point of each radial to determine the device boundary.

The polygon lies entirely inside the geographic area of the spectrum licence. Therefore, the device is operating in accordance with the conditions outlines in the relevant s.145 Determination and does not cause unacceptable interference in this case.

Figure 5.2 A polygon (the device boundary) demonstrating compliance with the relevant s145 Determination.



The device boundary is represented by the polygon which, essentially, demonstrates the transmitter's in-band emissions in a geographical sense. The device boundary criterion stipulates that the device boundary must fall inside the licence boundary of the corresponding licence. If it does, the device is then considered to not cause unacceptable interference to geographically adjacent licence areas.

The device boundary criterion is commonly expressed in an s145 Determination, using a variation of the basic formula:

$$\text{[Horizontally Radiated Power]} - \text{[Propagation Loss]} < \text{[Level of Protection]}$$

$$\text{HRP} - L_{\text{prop}} < \text{LOP} \quad (1)$$

Depending on the band, the device boundary criterion may be written slightly differently. For example, the 1800 MHz technical framework includes the Level of Protection (LOP) within its formula for 'maximum power' (MP) and writes the criterion as:

$$\text{RP} - \text{MP} < 0 \quad (2)$$

²⁷ The device boundary criterion is described in the applicable s145 determination for each spectrum licensed band.

As part of the industry working group process, appropriate values to establish the device boundary criterion will be considered. The types of values considered will include the following:

- **Propagation Model**

The propagation, or path loss, model applied is dependent on the spectrum licences being allocated and takes into account the frequency and geographic areas of the proposed licences. The propagation model often includes tailored formulas to be used for different path profile distances (e.g. $d < 20$ km, and $d > 20$ km). An example formula from the s145 Determination for the 1800 MHz band, is as follows:

For $0 < d < 20$ km the maximum power MP is:

$$MP = 34.6 \log (d + S) - 20.4 \log (h_e) + 43 \quad (3)$$

For $d > 20$ km;

$$MP = 58.9 \log (d + S) + 0.038h_e - 2.8h_e^{1/2} - 6.9 \quad (4)$$

where:

- d represents the distance in kilometres from the transmitter.
- h_e represents the effective antenna height²⁸ and should be calculated using RadDEM²⁹ elevation model data, available from ACMA.
- S represents the scaling parameter which is set to 4.8 by default. The scaling parameter can be used when negotiating a spectrum sharing agreement with affected licensees in cases where a device boundary falls outside the licensed geographical area.

For example, a licensee may vary the scaling parameter to reduce the size of the device boundary until it falls entirely within the licensed geographical area. This varied scaling parameter can then be used in a spectrum sharing agreement between spectrum licensees.

- **Level of Protection (LOP)**

The maximum or benchmark level of protection (LOP) for a receiver is usually based on the typical values derived from industry standards and may include factors such as receiver sensitivity, carrier to interference ratios and antenna gain. As these factors can vary depending on the type of technology used, the LOP values may be different in the various spectrum licensed bands.

The LOP benchmark is necessary for the calculation of the device boundary criterion, which is used to control emissions over the area boundaries. For example, if the HRP and propagation loss in all directions are such that a 'notional receiver' on the licence boundary is still protected, then the transmitter can be certified with an IIC.

²⁸ Calculations to determine the effective antenna height are discussed in section 5.2.2.

²⁹ RadDEM means the digital elevation model developed by ACMA for radiocommunications purposes that contains modelled terrain height information for Australia in cells of a size of 9 seconds of arc.

- **Horizontally Radiated Power (HRP)**

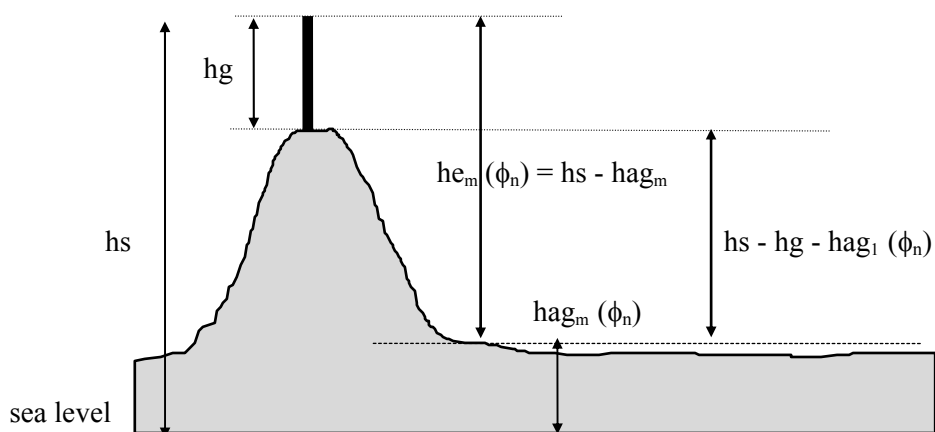
The out of area core condition is the maximum horizontally radiated power (HRP) permitted for a spectrum licence. The industry working group will recommend a maximum Equivalent Isotropically Radiated Power (EIRP) value through the definition of the out of area core condition. It is defined as the product of the transmitter's EIRP at the antenna connector, multiplied by the applicable antenna's gain relative to an isotropic antenna (dBi). A transmitter may use a transmit power up to the maximum EIRP, but must not exceed the maximum EIRP specified by the out of area core condition.

The application of a device boundary may then further reduce the radiated power to prevent unacceptable interference. A licensee may for example, work backwards to calculate the reduced HRP which will be permitted by the device boundary criterion, based on a transmitter's height, its proximity to the licence area boundary, and the path loss that will be experienced over a given profile. The HRP value when applied will also include a margin of error with a defined level of confidence.³⁰

5.2.2 Effective antenna heights and average ground heights

Effective antenna heights and average ground heights are important parameters within the propagation models. Each s145 Determination will detail the formula for calculating these heights. An example of the formula to calculate the effective antenna height $he_m(\phi_n)$ can be seen in figure 5.3, which is taken from the s145 Determination for the 1800 MHz band³¹.

Figure 5.3 Example of calculating effective antenna heights



hg: antenna height
 hs: antenna height above sea level

³⁰ In the 2 GHz Band s145 Determination for example, HRP includes an error value, defined as 'an uncertainty relating to the measured value of a parameter required to achieve a 95 % level of confidence that the true value of the parameter is within the range: (a) measured value minus uncertainty; to (b) measured value plus the uncertainty'. Other technical frameworks may vary slightly in the way in which they provide for a margin of error; however a 95 % level of confidence is commonly used.

³¹ It is important to note that under some conditions the formula in figure 5.3 may not apply, therefore it is advisable to consult the applicable s145 determination for further information.

$h_{g_m}(\phi_n)$: average ground height above sea level in segment 'm' of sector 'n'
 $h_{e_m}(\phi_n)$: effective antenna height for segment 'm' of sector 'n'

Note for this case $h_s - h_g - h_{g_1}(\phi_n) > 0$

The RadDEM software published by ACMA can be used to calculate tables of effective antenna heights or average ground heights for any location in Australia³².

5.2.3 Unacceptable Levels of Interference (s.145 Determinations)

The s.145 Determination provides guidance related to the certification of devices in accordance with the device boundary criterion for each spectrum licensed band. Essentially, the s.145 Determination specifies that if the operation of a device does not comply with the core conditions regarding out of area or out of band limits, the device is taken to have caused unacceptable interference. The s.145 Determination then outlines how an AP should apply the device boundary criterion, in order to verify whether a device complies with the core conditions of the relevant spectrum licensed band. Separate checks following acceptable engineering practice should also be made to ensure compliance with out of band core conditions.

In addition to the key parameters of HRP, propagation loss and LOP outlined above, the s.145 determination will also provide guidance on information to be used in assessing device boundary criterion calculations, including:

- The resolution of angle to be used for each radial (e.g. under the s145 determination for the 1800 MHz band, an AP should use a sector of 2.5 degrees arc);
- The resolution of segments (i.e. distances from the transmitter); and
- Guidance on the effective antenna height to be used for receivers, based on RadDEM data provided by ACMA.

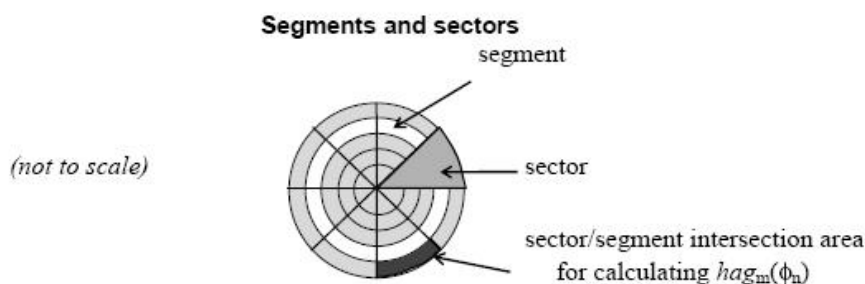
A comparison of the various sector resolution and segments sizes for the different spectrum licensed bands is shown in table 5.2. An illustration of segments and sectors is shown in figure 5.4.

³² See the ACMA website for information on purchasing the RadDEM software - http://www.acma.gov.au/WEB/STANDARD/pc=PC_1613

Table 5.2 Sector and segment resolution for device boundary criterion in different spectrum-licensed bands

Band	Year	Sector Resolution (degrees)	Segments (minutes)
2.3 GHz	1994-95	2.5	m·5
500 MHz	1997	10	m·5
800 MHz	1998	5	m·5
1800 MHz	1998	2.5	m·5
27/28/31GHz	1999	n/a	n/a
3.4 GHz	2000	2.5	m·5
2 GHz	2001	2.5	m·5

Figure 5.4 Segments and Sectors as defined for the purposes of device boundary criterion for spectrum licensing device registrations



5.2.4 Example – Device certification using Device Boundary Criterion

The following factors are assumed:

- A sectorised transmitter with a peak radiated power pattern of 50.5 dBm in a given direction;
- The signal propagation is over a uniform flat plane; and
- The effective antenna height $h_{e_m}(\phi_n)$ is 150 m for every 9 second RadDEM cell, and hence for every 5 minute segment for which the device boundary criterion is to be calculated.

An AP will apply the device boundary criterion outlined in the s145 Determination for each segment to ensure that the transmitter will pass the device boundary criterion for its planned operating parameters.

Transmitter 1: located near licence area boundary

- Frequency : 1800 MHz Band
- Device boundary criterion in the 1800 MHz s145 determination is specified as

RP – MP < 0

- RP = HRP + E – 0.8 dB (E = 95% level of confidence)
- MP is specified as:
 - For $0 < d < 20$ km the maximum power MP is calculated as:
 - $MP = 34.6 \log(d + S) - 20.4 \log(h_e) + 43$
 - For $d > 20$ km;
 - $MP = 58.9 \log(d + S) + 0.038h_e - 2.8h_e^{1/2} - 6.9$
- Radial/sector resolution: every $n \cdot 5/2 + 5/4$ degrees (i.e. every 2.5 degrees, starting at 1.25 degrees, for a total of 144 radials).
- Segment resolution: every $m \cdot 5$ minutes (m=1 to 30), which equates to approximately every 8 to 9 km, varying dependent on latitude. For a given segment, the effective height of the transmitting antenna will be calculated by averaging the RadDEM cells which fall within the segment area.

In the example calculations in table 5.3 below, the device boundary along the 2.5° degree radial at 68.75° for peak power 50.5dBm is found to be approximately 28 kilometres in this instance. The yellow cells indicate the first segment for which this device passes the device boundary criterion (that is when $RP - MP < 0$).

Table 5.3 Device boundary criterion calculations for transmitter with segment resolution for sectorised transmitter over uniform flat terrain ($h_{eff} = 150$ m) [Note: only a subset of radials are presented below; an AP would be required to calculate the device boundary for all radials specified, 144 in this instance]

5 min segments		1 st	2 nd	3 rd
sector(°)	HRP(dBm)	9.26Km	18.5km	27.8km
3.75	37.7 dBm	-1.43	-9.03	-16.72
21.25	42.7 dBm	3.57	-4.03	-11.72
38.75	48 dBm	8.87	1.27	-6.42
53.75	49.2 dBm	10.07	2.47	-5.22
68.75	50.5 dBm	11.37	3.77	-3.92
86.25	49.2 dBm	10.07	2.47	-5.22
103.75	47.9 dBm	8.77	1.17	-6.52
121.25	42 dBm	2.87	-4.73	-12.42
133.75	38.5 dBm	-0.63	-8.23	-15.92

5.3 Guard space

5.3.1 Overview

The basic principle of the guard space option is that an AP may issue an IIC if they are satisfied that a spectrum licensed transmitter is sufficiently isolated from other potentially affected devices, and therefore that it will not cause unacceptable interference to adjacent licensees. There is no set methodology for the use for the guard space option, however example methodologies that an AP may wish to use are provided below.

5.3.2 Application of the guard space option – far from the boundary

This option is applicable where a device is located some distance from its licence boundary, for example in the centre of a licence area. This often occurs in metropolitan licence areas. Unacceptable in band interference to area-adjacent licensees would be unlikely in such cases, and an AP may be confident in certifying that the device is sufficiently isolated.

Example - central geographic location (away from boundary)

In this scenario we assume there is a transmitter in the 2.3 GHz band (2302-2400 MHz) which is located approximately 100 km from the licence area boundary on all sides, operating with a maximum horizontally radiated power of 25 dBm / 30 kHz with an omnidirectional antenna.

An AP would likely consider the following:

- under the s145 determination for the 2.3 GHz band, the device does not quite meet the low power exemption of 21 dBm / 30 kHz, and so still requires registration.
- the method that the AP applies in order to satisfy themselves of the suitability of the guardspace option is a matter to be determined by the AP. This may be done by simple inspection, or by simplified emission calculations, in lieu of performing a full device boundary criterion test. This could include:
 - horizontally radiated power to the closest licence area boundary;
 - horizontally radiated power along the flattest path, where the propagation losses may be the lowest (e.g. for a isotropic transmitter); or
 - horizontally radiated power along a radial or series of radials with peak radiated power for a sectorised transmitter.

Any checks or methods used are at the discretion of the AP; the only requirement is that the AP is satisfied that sufficient guardspace is allocated to mitigate potential interference from the transmitter, in accordance with the *Radiocommunications Advisory Guidelines (Registration of Devices under Spectrum Licences without an Interference Impact Certificate) 1998*.

5.3.3 Varying deployment constraints

The guard space option can also be used to enable registration for devices that do not comply with the deployment constraints specified in the applicable s145 Determination. Deployment constraints may include maximum allowable heights for transmitters operating in specified frequency bands, and maximum allowable antenna beamwidths for transmitters operating in specific frequency bands.

Where the operation of a device does not comply with a deployment constraint an AP may still issue an IIC if they are satisfied that sufficient guard space is allocated to mitigate potential interference from the transmitter. Guard space may be implemented using either the guard-area or guard-band that has been sourced from within the licensee's spectrum licence.

Guard-area is where a licensee provides sufficient geographical space between their transmitter and any potentially affected receivers. For example, a licensee may locate their

transmitter well away from their licensed geographical boundary to mitigate interference to receivers in adjacent licensed areas.

Guard-band is where a licensee provides sufficient frequency space between their transmitter and any potentially affected receiver. For example, a licensee may use a transmit frequency that is well away from their licensed frequency boundaries. This will provide frequency separation from any frequency adjacent receivers.

A combination of guard-area and guard-band may be used to further isolate a transmitter from potentially affected receivers, where necessary.

5.3.4 Submitting Registration for Guardspace-certified Devices

To indicate to other RRL users that the device has been certified using the guardspace option, the device will be denoted in the RRL with a Y in the guardspace³³ field. Further guidance on submitting registration information to ACMA can be found in section 5.5.

5.3.5 Additional information

Some additional information regarding the guard space option is provided in the two legislative instruments listed below:

- *Radiocommunications (Section 145(3) Certificates) Determination*³⁴, made under Section 266A. This instrument outlines the arrangements by which an AP should issue an IIC for the purposes of device registration. The exact wording of the instrument in relation to internal guardspace is as follows:

‘the accredited person is satisfied that sufficient internal guardspace has been allocated to mitigate potential interference from the transmitter, in accordance with the *Radiocommunications Advisory Guidelines (Registration of Devices under Spectrum Licences without an Interference Impact Certificate) 1998*³⁵’.

- *Radiocommunications Advisory Guidelines (Registration of Devices under Spectrum Licences without an Interference Impact Certificate) 1998*³⁶ made under Section 262 of the Act. This advisory guideline can be used by licensees in all spectrum licensed bands and provides further advice relating to guard space.

The information presented here should be considered alongside the relevant instrument when determining the approach to use in applying the guard space certification option.

³³ In terms of RRL Database elements, guardspace is indicated in the field *sys_g_spc* ‘Guardspace exists’. See http://www.acma.gov.au/WEB/STANDARD/pc=PC_505 for more information.

³⁴ The instrument is available from the ComLaw website at - <http://www.comlaw.gov.au/ComLaw/Legislation/LegislativeInstrument1.nsf/asmade/bytitle/B2B796B5A48ABE48CA256F8E00102F01?OpenDocument>

³⁵ It is important to note the anomaly that the guideline refers to registration ‘without an Interference Impact Certificate’. Administratively, under the original registration process an IIC was not issued for the guardspace or agreement options. Amendment in 2005 meant IICs are now issued for any transmitter regardless of the method used, bringing procedural consistency with the default DBC option. The instrument is available from the ComLaw website at <http://www.comlaw.gov.au/ComLaw/Legislation/LegislativeInstrument1.nsf/0/E046CA030A55C738CA25709A000D5A2F?OpenDocument&VIEWCAT=item&COUNT=999&START=1>

³⁶ See - [http://www.comlaw.gov.au/ComLaw/Legislation/LegislativeInstrument1.nsf/0/EA1DBEB77A7C1AA6CA256FD400287054/\\$file/agregofdevices98.doc](http://www.comlaw.gov.au/ComLaw/Legislation/LegislativeInstrument1.nsf/0/EA1DBEB77A7C1AA6CA256FD400287054/$file/agregofdevices98.doc)

5.4 Spectrum Sharing Agreement Option

5.4.1 Overview

Another option available to licensees is for device registration in situations where a device does not pass the device boundary criterion due to emissions spilling over into adjacent spectrum space. If a spectrum licensee obtains agreements with all band- or area-adjacent licensees affected by emissions, ACMA will accept the device registration. The exact wording of the s266A instrument that permits spectrum sharing agreements is that a device can be issued an IIC if:

‘the accredited person is satisfied that consent in writing to interference from the transmitter has been given by all licensees who in the opinion of the accredited person may be affected by the interference.’³⁷

There is no set format for written consent to be given between parties. The device boundary criteria in some technical frameworks have included a scaling parameter S for the specific purpose of making spectrum sharing agreements. The *Radiocommunications Advisory Guidelines (Registration of Devices under Spectrum Licences without an Interference Impact Certificate) 1998* states that the first licensee may perform a device boundary criterion calculation with a varied S parameter until the device boundary falls entirely within its licensed geographical area. This single value for S is then accepted under agreement between area-adjacent licensees and establishes a level of certainty about emissions. Different scaling parameters could be used with different licensees as required.

Difference between spectrum sharing agreements and core condition agreements

Note - there is a clear difference between spectrum sharing agreements and core condition agreements. Spectrum sharing agreements relate to device certification and registration, and are device-specific.

Core condition agreements, in contrast, are licence-specific and in general relate to arrangements struck between spectrum licensees and legacy apparatus licensees to facilitate continued operation of legacy apparatus-licensed devices, often where emissions of the apparatus-licensed devices overlap two spectrum licensed areas. For more information see the ACMA website³⁸.

5.4.2 Additional Guidance

As an alternative to the scaling parameter, licensees may choose to negotiate spectrum sharing agreements about emissions using different path-loss models to that used in the s145 determination. Depending on the method used, the agreement may then be stated in some

³⁷ See section 5 of *Radiocommunications (section 145 (3) Certificates) Determination*.

³⁸ See http://www.acma.gov.au/WEB/STANDARD/pc=PC_2871

other terms (i.e. not an S parameter), such as a reduced horizontally radiated power for which licensees are confident that unacceptable levels of interference will not be caused.

Spectrum licensees should also note that in the event the affected party is an apparatus licensee, or the emissions affect unlicensed spectrum space, the licensee should make a spectrum sharing agreement with ACMA.

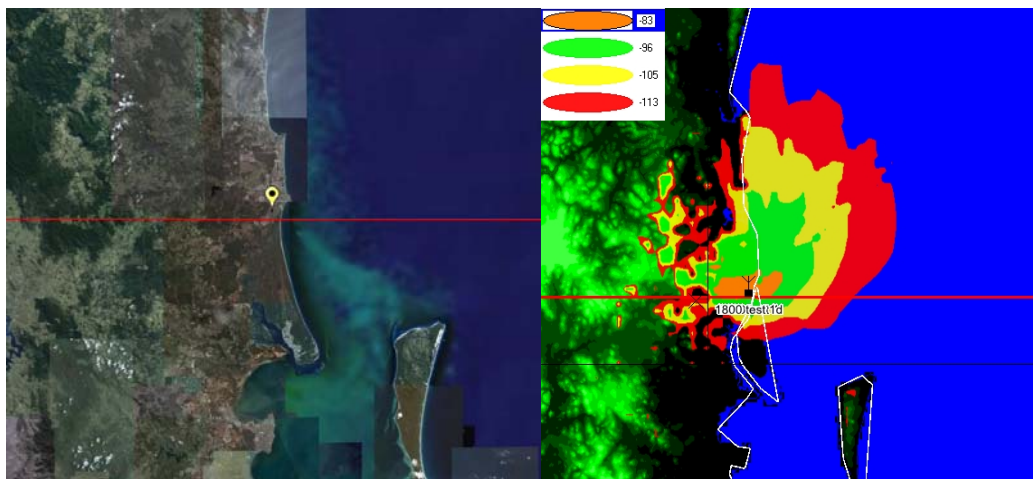
Further information can be found in the following documents:

- *Radiocommunications (Section 145(3) Certificates) Determination*; and
- *Radiocommunications Advisory Guidelines (Registration of Devices under Spectrum Licences without an Interference Impact Certificate) 1998*.

5.4.3 Example – Certification using Spectrum Sharing Agreement

A spectrum sharing agreement may be sought by a licensee where their device is located near a licence area boundary, and will not meet the device boundary criterion, resulting in some emissions spilling over into an adjacent licensee’s spectrum space. An example of this is shown in figure 5.6.

Figure 5.6 (a) shows an 1800 MHz transmitter (indicated by the yellow marker) located near a licence area boundary (indicated in red). 5.6 (b) shows the radiated power pattern (designated by the coloured shapes) from the same transmitter. As some emissions are spilling over the geographical licence boundary a spectrum sharing agreement may need to be created with the affected licensee.



In a scenario where a spectrum sharing agreement is required, the licensee should begin by consulting the RRL to identify devices which may be affected and collect licensee details. In the example depicted in Figure 5.6, the licensee may need to negotiate a spectrum sharing agreement with the area-adjacent licensee due to the potential of their transmitted emissions spilling into the neighbouring licence area.

The AP will sign off that the licensee has negotiated agreements with all persons who, in their opinion, may be affected by interference caused by the device in question. Only then should the AP issue the IIC using the spectrum sharing agreement option. When submitting the *Application to Register a Radiocommunications Device(s) Operated under a Spectrum*

Licence Form an AP may provide agreement identification numbers for all agreements applicable to the licence under which the device is being registered.

Note that ACMA does not collect or retain information on the detail or nature of agreements. Licensees, however, should retain copies of all agreements which they have entered for record keeping purposes. APs should also keep records of spectrum sharing agreements that they have sighted for the purpose of registering a device.

5.4.4 Submitting Registration for spectrum sharing agreement-certified Devices

When submitting the *Application to Register a Radiocommunications Device(s) Operated under a Spectrum Licence Form* (R070) to ACMA, an AP should tick the ‘External Guardspace’ column against the applicable device. The AP should also still submit a *Device Details for Transmitters Form* (R072) as an annexe to the *Application to Register a Radiocommunications Device(s) Operated under a Spectrum Licence Form*. When registered into the RRL, a device for which a spectrum sharing agreement exists may be denoted by the presence of an agreement number in the agreement ID field³⁹. This number will correspond to the ID number used by the licensee and AP for record-keeping. It does not reflect any agreement database held by ACMA.

5.5 Submitting Information for Registration into RRL

5.5.1 Registration Process

Once a transmitter is certified by an AP using one of the accepted IIC methodologies, a licensee may submit transmitter details to ACMA for inclusion in the RRL.

Information submitted into the RRL is used for a number of interference management tasks that all radiocommunications users typically undertake. Preventative coordination tasks, as discussed in Chapter 6, require RRL data to coordinate against spectrum-licensed transmitters and receivers. Licensees or APs may also develop automated coordination tools, which are dependent upon the currency of RRL data.

Interference resolution, discussed in Chapter 7, is also dependent on accurate and up-to-date RRL data, to permit a licensee to quickly identify possible sources of interference, contact licensees of devices causing interference and take steps to resolve any problems which are preventing normal operation of their devices.

More information on device registration can be found on the ACMA website⁴⁰.

5.5.2 Required Information

Once an AP has established that a device will not cause unacceptable levels of interference, the device can be certified and the registration can be submitted to ACMA for inclusion in the Register. The AP must submit required information using specific forms which ACMA provides. These forms are:

³⁹ In terms of RRL Database elements, the agreement option is indicated in the field (sys_ag_id) ‘Agreement ID’. See http://www.acma.gov.au/WEB/STANDARD/pc=PC_505 for more information.

⁴⁰ See - http://www.acma.gov.au/WEB/STANDARD/pc=PC_310738

- ***Application to Register a Radiocommunications Device(s) Operated under a Spectrum Licence Form (R070)*** – Application to register a radiocommunications device(s) operated under a spectrum licence. This form is to be used by an AP to register one or more transmitters or receivers under a spectrum licence.
- ***Device Details for Transmitters Form (R072)*** – This form is to be used to provide details on transmitters listed on an associated *Application to Register a Radiocommunications Device(s) Operated under a Spectrum Licence Form*. Specific details required include the transmit power of the device, including a radiated power pattern for sectorised devices.
- ***Device Details for Receivers Form (R071)*** – This form is to be used to provide details on receivers listed on an associated *Application to Register a Radiocommunications Device(s) Operated under a Spectrum Licence Form*.

The full set of information that must be included in the database for registered devices is determined by the *Radiocommunications (Register of Radiocommunications Licences) Determination 1997* made under sections 144, 147 and 149 of the Act. This determination sets out the details required for the registration of spectrum licensed devices⁴¹. These details can also be seen on the respective device details for transmitters and receivers forms.

5.4.3 Register Updates

Every spectrum licence stipulates that a transmitter which has not been exempted from registration may not be operated unless device registration requirements under Part 3.5 of the Act have been met, and that the device complies with its corresponding technical details entered in the RRL.

From time to time licensees may wish to alter the operating parameters for devices operated under a spectrum licence. In these situations, the obligation is on the licensee to ensure that the RRL is updated as necessary. Failure to do so and continuing to operate a device may constitute an offence under the Act.

Maintaining the register as accurately as possible enables effective coordination between existing and proposed services for all users of the RRL. As proposed services will be coordinated with nearby existing services, an accurate register will help prevent harmful interference between users. ACMA provides daily updates online and to CD-ROM subscribers. More information on the RRL database and available versions can be found on the ACMA website⁴².

⁴¹ For a full list of these details see - [http://www.comlaw.gov.au/ComLaw/Legislation/LegislativeInstrument1.nsf/0/15E7F876E8EE02AACA2572B2001A5069/\\$file/RegisterofRadiocommunicationsLicencesDet1997.pdf](http://www.comlaw.gov.au/ComLaw/Legislation/LegislativeInstrument1.nsf/0/15E7F876E8EE02AACA2572B2001A5069/$file/RegisterofRadiocommunicationsLicencesDet1997.pdf)

⁴² http://www.acma.gov.au/WEB/STANDARD/pc=PC_1613

6 Advisory Interference Management

6.1 Overview

Additional interference management procedures, based on the issues identified during the industry working group process, are provided in Radiocommunications Advisory Guidelines made under section 262 of the Act. These guidelines are for use by all radiocommunications users who have the potential to cause interference to spectrum licensed receivers, and by spectrum licensees who have the potential to cause interference to apparatus or class licensed receivers.

The s262 guidelines outline mechanisms to enable effective coordination between spectrum users. Generally there are two guidelines for each band, one relating to protection of spectrum licensed receivers, the other relating to the protection of frequency-adjacent apparatus and class licensed receivers⁴³.

6.2 Protection of Spectrum Licensed Receivers

6.2.1 Managing Out-of-Band Interference

Out-of-band interference refers to a number of non-linear types of interference that may occur across the frequency boundaries of licences. Managing out-of-band interference presents a different challenge compared to in-band interference because of the difficulties of accurately predicting the levels of unwanted emissions. Out-of-band interference relates to both the proximity, and the operating frequencies, of transmitters and receivers. It also:

- has the potential to extend either side of the frequency boundary of the spectrum licence for many MHz; and
- is dependent on the quality of the receiver as well as the levels of transmitter emission.

As a result of the above, the s262 guidelines have adopted minimum level of receiver performance requirements to manage out-of-band interference. These receiver requirements are used in conjunction with receiver registration⁴⁴ and the compatibility requirements⁴⁵, to

⁴³ Some bands have additional s262 guidelines applicable to them. It is advisable to consult the relevant technical framework documentation to determine the actual s262 guidelines for that spectrum licensed band. Technical frameworks can be found on the ACMA website - http://www.acma.gov.au/WEB/STANDARD/pc=PC_1583

⁴⁴ Registration is discussed further in section 6.2.4.

manage out-of-band interference occurring in spectrum licensed receivers caused by transmitters operated in frequency-adjacent bands.

6.2.2 Receiver benchmarks

A receiver's ability to tolerate out-of-band interference can be represented by benchmarks for selectivity, blocking, intermodulation immunity and spurious response immunity characteristics. A general description of these benchmarks and how they relate to the receiver's characteristics are as follows:

- **Selectivity** – A measure of the ability of the receiver to receive a wanted signal in the presence of an unwanted frequency-adjacent signal at a given frequency offset. Selectivity of a receiver relates to its Radio Frequency (RF) and Intermediate Frequency (IF) bandwidth specifications.
- **Intermodulation immunity** - A measure of the ability of the receiver to receive a wanted signal without the receiver's grade of service falling below the compatibility requirement due to the presence of two or more unwanted interfering signals which have a specific frequency relationship to the wanted signal. This immunity relates to the RF bandwidth and linearity performance characteristics of the receiver.
- **Receiver blocking** – A measure of the ability of a receiver to receive a wanted signal, in the presence of a high level unwanted interferer on frequencies other than those of the adjacent channels. Receiver blocking relates to the receivers RF bandwidth characteristics.
- **Spurious response immunity** – A measure of the ability of the receiver to discriminate between the wanted signal at its nominal frequency and an unwanted signal to which the receiver responds. Spurious response immunity is related to the RF bandwidth and signal mixing characteristics of the receiver.

A minimum level of receiver performance has to be specified in conjunction with the compatibility requirements because the performance level of receivers:

- affects the level of interference; and
- varies widely for receivers operating under spectrum licences.

6.2.3 Example of receiver performance

Using the *Radiocommunications Advisory Guidelines (Managing Interference to Receivers – 2.3 GHz Band) 2008*⁴⁶ as an example:

Figures 6.1(a) and 6.1(b) demonstrate the minimum IF and RF characteristics of the receiver which aims at limiting out-of-band interference from frequency-adjacent transmitters.

⁴⁵ Compatibility Requirements are discussed further in section 6.2.5.

⁴⁶ The Radiocommunications Advisory Guidelines (Managing Interference to Receivers – 2.3 GHz Band) 2008 is currently in draft form and is available on the ACMA website, see - http://www.acma.gov.au/webwr/_assets/main/lib310638/attachmentc-rag_interference_to_receivers.pdf

Figure 6.1(a) Minimum IF characteristics for the 2.3 GHz band, frequency offset is measured from the edge of the channel.

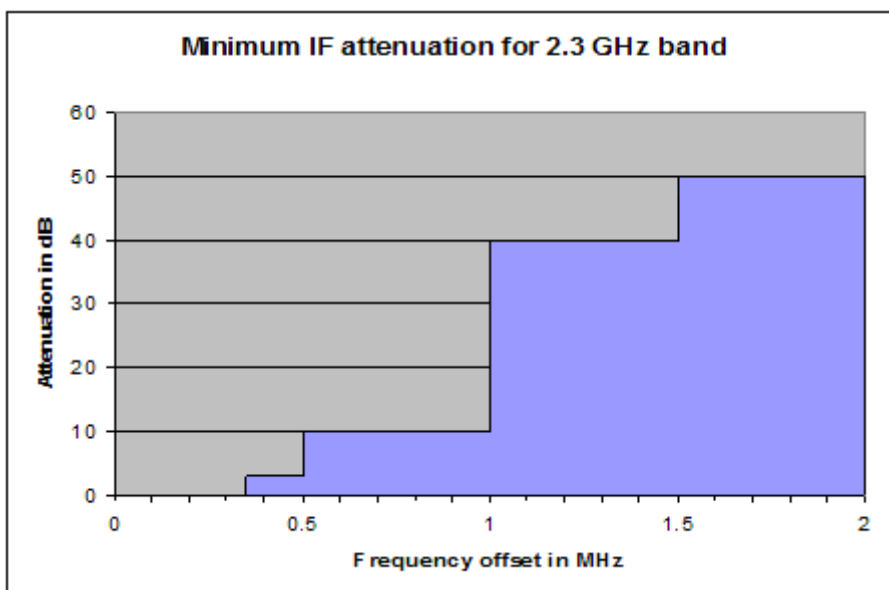
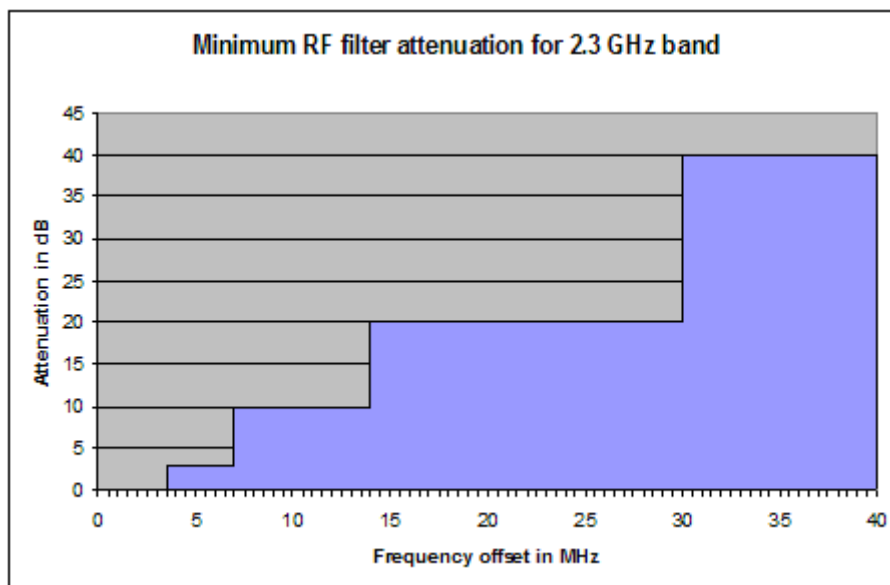


Figure 6.1(b) Minimum RF characteristics for the 2.3 GHz band, frequency offset is measured from the edge of the channel



The receiver linearity performance requirements are aimed at reducing the potential for harmful intermodulation signals to be produced within the receiver. Table 6.1 details the minimum conversion ratios specifications for the three most common intermodulation products.

Table 6.1 Minimum intermodulation conversion ratios for the 2.3 GHz band

Intermodulation Type	Conversion Ratio (dB)
Two-signal Third-order ($2A \pm B$)	11
Two-signal Fifth-order ($3A \pm 2B$)	28
Three-signal Third-order ($A \pm B \pm C$)	5

The minimum unwanted signal level to cause receiver blocking for receivers operated in the 2.3 GHz band is a signal level of -45dBm per 30 KHz with a frequency offset of 7 MHz or more.

It is important to note that receiver performance criteria can be specified in different ways depending on the specific band in which the receiver is operating.

6.2.4 Receiver registration

Although the registration of receivers operated under a spectrum licence in the RRL is not mandatory, it is recommended for the purpose of managing out-of-band interference. Registration of receivers that meet the minimum benchmarks can help prevent instances of interference and can reduce operational costs for spectrum licensees.

Devices are able to be registered without meeting the minimum level of receiver performance; however this scenario will lower the level of protection afforded to it.

Table 6.2 shows examples of different levels of receiver protection depending on which components of the applicable s262 guideline are met.

Table 6.2 Example of different levels of protection

Receiver compliance with s262 guidelines	Amount of potential coordination	Level of receiver protection
Receiver is not registered in the RRL	No obligation for frequency-adjacent transmitters to coordinate with receiver	Very little protection
Receiver is registered but doesn't meet Minimum Level of Receiver Performance	Transmitters may coordinate with it as it appears in the RRL, however compatibility requirements from s262 may not apply	Some protection may be afforded, however may not be assured
Receiver is registered, meets the Minimum Level of Receiver Performance and any other applicable criteria in s262 guidelines	Frequency-adjacent transmitters are required to meet the compatibility requirements and coordinate with the receiver	High level of protection is afforded to the receiver

Receivers that have not been registered will have limited or no visibility to other spectrum users installing nearby transmitters, which means they most likely will not be afforded protection against out-of-band interference. When a receiver is registered the likelihood of out-of-band interference is reduced, meaning the licensee is less likely to deal with service down time experienced during the interference resolution process.

How to register a receiver

To register a spectrum licensed receiver in the RRL, the following forms need to be completed and forwarded to ACMA:

- *Application to Register a Radiocommunications Device(s) Operated under a Spectrum Licence Form (R070)*⁴⁷; and
- *Device Details for Receivers Form (R071)*⁴⁸: This form is to be used to provide details on receivers listed on an *associated Application to register a radiocommunications device(s) operated under a spectrum licence Form*.

Registering groups of receivers

ACMA also provides options for simplifying the registration of receivers that operate with the same parameters. If two or more receivers are operated for the purpose of communicating with the same transmitter or same group of transmitters and they use the same type of antenna, then those receivers may be treated as a group in order to simplify the registration process.⁴⁹ A receiver may belong to more than one group. Groups are defined to help minimise the work associated with the registration process of similar receivers. More information on groups of receivers can be found in the s145 determination for the respective spectrum-licensed band.⁵⁰

6.2.5 Coordination

To assist the task of coordinating frequency-adjacent transmitters with existing spectrum licensed receivers, the s262 guidelines specify compatibility requirements. These requirements aim to set a protection level for receivers to which transmitters must maintain after certain criteria have been met by the receiver licensee.

For example, the compatibility requirement for the 2 GHz spectrum licensed band is:

⁴⁷ The Application to Register a Radiocommunications Device(s) Operated under a Spectrum Licence Form (R070) can be down loaded from the ACMA website - http://www.acma.gov.au/webwr/_assets/main/lib310172/r070-application_to_register_a_radiocommunications_device.pdf

⁴⁸ The Device Details for Receivers (R071) form can be downloaded from the ACMA website - http://www.acma.gov.au/webwr/_assets/main/lib310172/r071-device_details_for_receivers.pdf

⁴⁹ It is important to note that the receiver group definitions may vary depending on the spectrum licence band in which it is operating. Consultation of the applicable s145 determination is recommended.

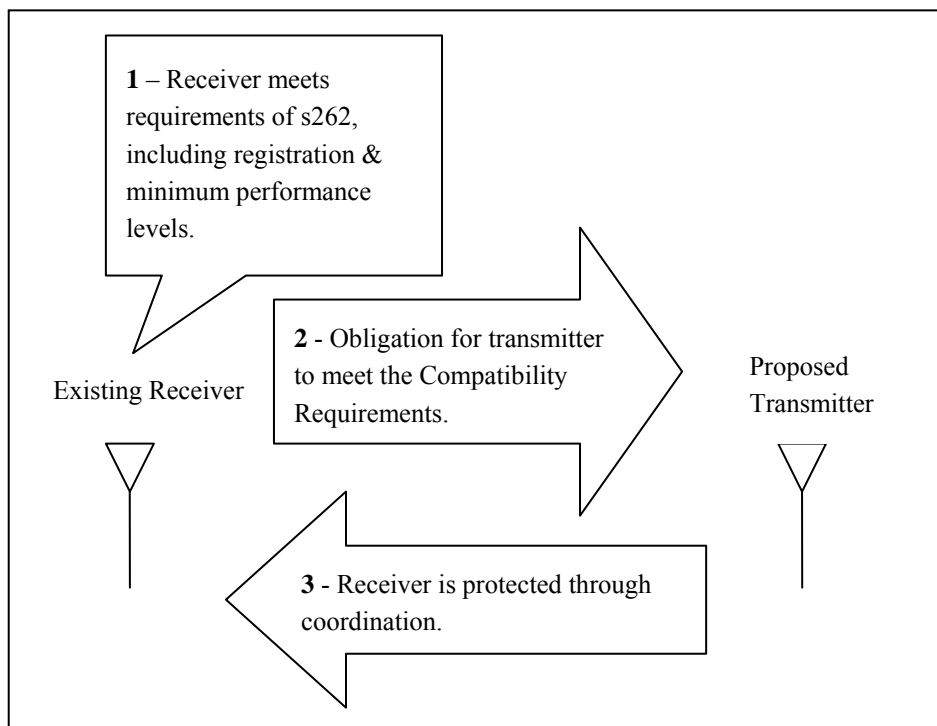
⁵⁰ The s145 determinations can be found on the ACMA website - http://www.acma.gov.au/WEB/STANDARD/pc=PC_6059

An unwanted signal level that is never more than -126 dBm for more than 1% of the time in any 1 hour period; when measured as mean power within a 30 kHz rectangular bandwidth that is within the frequency band of the spectrum licence.⁵¹

Example of the coordination process

Figure 6.2 shows an example of the basic coordination process between an existing receiver and a proposed transmitter.

Figure 6.2 Example of a proposed transmitter coordinating with an existing receiver



Note: There are still mechanisms to deal with interference to receivers that are not registered; however possible interference resolutions may be limited.

As shown in figure 6.2, proposed frequency-adjacent transmitters will need to meet the compatibility requirements with existing spectrum licensed receivers if:

- the receiver is already registered in the RRL; and
- the receiver meets the minimum level of receiver performance specifications in the applicable s262 guideline; and
- the receiver meets any other conditions as specified by the applicable s262 guideline.

⁵¹ The Compatibility Requirement for the 2 GHz spectrum licensed band can be found in the Radiocommunications Advisory Guidelines (Managing Interference from Apparatus-licensed and Class-licensed Transmitters – 2 GHz Band) 2000

6.3 Protection of Apparatus and Class Licensed Receivers

The s262 guidelines have also been designed to provide apparatus and class licensees with some protection from transmitters operated under a spectrum licence. In general, the guidelines outline types of services (either within the spectrum licensed band or adjacent to it) that spectrum licensees may need to coordinate with, as well as detailing protection requirements that are aimed at managing any potential interference. Protection requirements may include a decreased radiated power limit at frequencies close to the boundary of the spectrum licensed band, which will help protect services operated in adjacent bands.

As potentially affected services vary considerably in the different spectrum licensed bands, it is advisable to consult the applicable s262 guidelines for the band in which the spectrum licensed devices are deployed.

6.4 The First-in-time Approach

A general aid to assist coordination between services is the first-in-time approach. This approach consists of varying the details of the most recently registered device in order to eliminate or reduce the interference – unless the other devices are not operating in accordance with their licence conditions.

This method has the potential to resolve interference disputes where all parties are operating within their respective licence conditions in a fair and impartial manner. Some s262 guidelines contain additional advice on the first-in-time approach for particular spectrum licensed bands.

7 Ongoing Interference Management

7.1 Interference a licensee must manage

No matter how rigorous the engineering analysis of a device, there is always a possibility of actual interference when devices are deployed in the field. Interference to spectrum licensed devices can come from other radiocommunications services, or from faulty or noisy electrical or electronic devices commonly in use. Such interference may be caused by emissions at frequencies either inside or outside the licensees' spectrum space.

In cases where interference is experienced, the spectrum licence places certain obligations on the licensee to investigate and manage the issue without the involvement of ACMA. These obligations include the following:

1. The licensee must manage interference⁵² between radiocommunications devices operated under their licence, and between radiocommunications devices operated under their licence and under any other spectrum licence held by the licensee.

For example, it is possible for many of the devices within a single network to be licensed under separate spectrum licences. As a single licensee is in control of these devices, any interference experienced between the devices must be managed by the licensee.

2. The licensee must take reasonable steps to negotiate arrangements likely to reduce the interference to acceptable levels where interference occurs between a spectrum licensed device and any other radiocommunications device that are located within 200 metres of each other. These arrangements should be made with the holder of the other licence or if a site manager is responsible for managing interference at that location, that site manager.

⁵² Managing interference, includes:

- (a) investigating the possible causes of the interference; and
- (b) taking all steps reasonably necessary to resolve disputes about interference where more than 1 person is involved; and
- (c) taking steps (or requiring persons authorised to operate devices under this licence to take steps) reasonably likely to reduce interference to acceptable levels; and
- (d) negotiating with other persons to reduce interference to acceptable levels.

An example of this is where two licensees share a common tower. Even if both licensees are operating within their respective licence conditions the potential for interference to occur still exists. It is also important to note that site infrastructure such as the towers, buildings and fencing can also be a factor in the production of interference. Cooperation between co-sited licensees and site managers/owners is essential in the diagnosis and resolution of interference.

Note: some spectrum licences contain additional circumstances where licensees are to manage interference without the involvement of ACMA. Licensees can determine if any additional conditions apply to them by consulting their spectrum licence issued by ACMA.

7.2 Licensee obligations prior to contacting ACMA regarding interference

If, after addressing the above obligations, the spectrum licensee is still experiencing interference, a complaint can be made to ACMA. However, before making the complaint it is advised that the licensee take all reasonable steps to ensure that:

- The operation of their device/s meets all the conditions of their licence.
- The interference is not produced by infrastructure or equipment which is under the licensee's control. For example, faulty lighting or noisy power supplies within the on-site equipment hut have the potential to cause harmful interference.
- The interference complaint is genuine.
- The interference is not caused by a fault within their own system. For example, it is possible for an interference signal to be produced internally due to a faulty antenna, poor cable terminations or insufficient filtering.
- They have researched the RRL to identify any services that may potentially be the source of interference. Searches of the RRL will provide information of existing services that are located nearby to the affected service, in both geographic and frequency terms. This investigation may indicate the likely cause of the interference and it may be possible to settle the problem without ACMA's intervention
- The affected receiver meets the minimum level of receiver performance as determined in the relevant Advisory Guideline. Minimum receiver performance guidelines are aimed at helping to maintain a level of reliability for receivers operating in the field.
- The receiver details are correctly registered in the RRL. A receiver will not generally be afforded protection unless details of the receiver are in the Register.

Interference that is suspected to be caused by a breach of the Radiocommunications Act 1992, such as an unlicensed operation, should be reported to ACMA as detailed in section 7.3.

Note, if ACMA becomes involved before all of the above points have been addressed, licensees may be charged for any work undertaken.

7.3 Making an interference complaint to ACMA

Interference complaints to ACMA should be made using the following form

- *Interference Complaint for Receivers Operated Under a Spectrum Licence Form (R111)*.⁵³

Any additional relevant information that can be provided may further help in the interference resolution process, for example; spectrum plots, times of interference, etc.

More information on managing interference can be found in the relevant technical framework⁵⁴ documents for the given band.

⁵³ The R111 interference form can be found on the ACMA website -

http://www.acma.gov.au/webwr/_assets/main/lib310172/r111-interference_complaint_for_receivers_operated_under_a_spectrum_licence.pdf

⁵⁴ The technical framework documents for the various spectrum licensed bands can be found on the ACMA website - http://www.acma.gov.au/WEB/STANDARD/pc=PC_1583

Appendix 1 – Transmitter certification and registration flowchart

