
Radiocommunications Assignment and Licensing Instruction

**Frequency Coordination and Licensing Procedures
for Apparatus Licensed
Broadband Wireless Access
Services in the
1900-1920 MHz and 3575-3700 MHz Bands**

RADIOCOMMUNICATIONS ASSIGNMENT AND LICENSING INSTRUCTIONS

DISCLAIMER

The Australian Communications and Media Authority (ACMA) advise that these instructions reflect the current policies of the ACMA.

Prospective applicants for licences should take all necessary steps to ensure that they have access to appropriate technical and other specialist advice independently of the ACMA concerning their applications, the operation of radiocommunications equipment and services, and any other matters relevant to the operation of transmitters and services under the licences in question.

The policies of the ACMA and the laws of the Commonwealth may change from time to time, and prospective licensees should ensure that they have informed themselves of the current policies of the ACMA and of any relevant legislation (including subordinate instruments). Prospective applicants for licences should not rely on statements made in these instructions about the policies that may be followed by other government authorities or entities, nor about the effect of legislation. These instructions are not a substitute for independent advice (legal or otherwise) tailored to the circumstances of individual applicants.

Radiocommunications Assignment and Licensing Instructions are subject to periodic review and are amended as the ACMA considers necessary. To keep abreast of developments, it is important that users ensure that they are in possession of the latest edition.

No liability is or will be accepted by the Minister or the Department of Communications, the ACMA, the Commonwealth of Australia, or its officers, servants or agents for any loss suffered, whether arising directly or indirectly, due to reliance on the accuracy or contents of these instructions.

This RALI deals with assigning licences that are likely use time-division-duplex (TDD) technology. TDD differs in some of its frequency coordination aspects from the frequency-division-duplex (FDD) point-to-point fixed link technology and FSS Earth stations that are commonly used in these bands. Accordingly, the ACMA anticipates that refinements could be made to this document once experience is gained with the use of TDD technology and the application of this RALI.

Suggestions for improvements to Radiocommunications Assignment and Licensing Instructions may be addressed to The Manager, Spectrum Engineering, ACMA at PO Box 78, Belconnen, ACT, 2616, or by e-mail to fregplan@acma.gov.au. It would be appreciated if notification to the ACMA of any inaccuracy or ambiguity found be made without delay in order that the matter may be investigated and appropriate action taken.

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AMENDMENT HISTORY

Date of Effect	Sequence Number	Comments
July 2018		Updated coordination criteria between BWA and spectrum licence services due to the Ministerial declarations re-allocating the 3575-3700 MHz band for the issue of spectrum licences in regional and metropolitan areas.
March 2017		Minor update to correct the frequency for channel 3 in Figure 1 and to add areas to the maps at Attachment 1a and 1b to reflect the permitted deployment areas described in the document.
July 2015		<p>Due to the Revocation of the <i>1900-1920 MHz and 2010-2025 MHz Bands Frequency Band Plan 2004</i> and the creation of the <i>1900-1920 MHz Frequency Band Plan 2012</i> all references to the 2010-2025 MHz band have been removed from this RALI.</p> <p>Incorporated 20 MHz channelling arrangements into the 3575-3700 MHz band. Noting 15 MHz and 30 MHz channelling no longer apply to new licences. References updated.</p>
8 August 2011	186	Removed 30 MHz assignment limit on licensees operating in the same area in the 3.6 GHz band.
24 March 2010	178	Updated coordination between BWA base stations and Fixed link receivers.
11 March 2010	176	Updated to include coordination criteria between BWA in the 1900-1920 MHz band and PTS in the 1920-1980 MHz band, as well as specific criteria for coordination between 10 MHz and 20 MHz BWA systems in the 1900-1920 MHz band.
11 September 2009	173	<p>Update to include the 3575-3700 MHz band and coordination procedures with BWA services, point-to-point links, amateur services, radiolocation services, FSS Earth Stations, adjacent band spectrum licensed devices as well as the Radio Quiet Zone and other specific areas.</p> <p>Removal of “roll out goals” and the 10 MHz spectrum acquisition limit in the 1900-1920 MHz and 2010-2025 MHz bands.</p> <p>Addition of Attachment 5: ‘Coordination of BWA licences with adjacent channel 3.4 GHz spectrum licensed devices’.</p> <p>Addition of Attachment 6: ‘Coordination of BWA</p>

		licences with Earth Stations’. Removal of special conditions and specific advisory notes from RALI FX19 and placement in the <i>Radiocommunications Licence Conditions (Fixed Licence) Determination 1997</i> .
15 August 2007	170	Update to clarify coordination requirements between BWA services as well as spectrum licensed areas.
26 April 2005	166	Initial release

Frequency coordination and licensing procedures for apparatus licensed Broadband Wireless Access (BWA) services in the 1900-1920 MHz and the 3575-3700 MHz bands

Part 1: Introduction

1.1 Purpose

The purpose of this Radiocommunications Assignment and Licensing Instruction (RALI) is to provide information about, and describe necessary steps for the frequency coordination and licensing of apparatus licensed point-to-multipoint fixed broadband wireless access services (BWA) in the 1900-1920 MHz and 3575-3700 MHz bands.

The information in this document reflects the ACMA's statement of current policy in relation to frequency coordination and apparatus licensing of BWA systems in the 1900-1920 MHz and 3575-3700 MHz frequency ranges. In making decisions, ACMA assigners and Accredited Persons should take all relevant matters into account and decide each case on its merits. Issues related to these procedures that appear to fall outside of the established policy should be brought to the attention of:

The Manager - Spectrum Engineering Section
Spectrum Planning and Engineering Branch
Australian Communications and Media Authority
P.O. Box 78
Belconnen ACT 2616

A glossary of acronyms and abbreviations is provided at page 46.

1.2 Basic Principles

The basic principles for coordination and operation of BWA systems in the 1900-1920 MHz and 3575-3700 MHz bands are that:

- apparatus licensed BWA systems may only be licensed in defined regional and remote areas for 1900-1920 MHz and defined regional and remote areas for the 3575-3700 MHz band;
- the operation of apparatus licensed BWA systems must not cause unacceptable interference to other previously licensed BWA systems or other licensed co-primary services as defined in the *1900-1920 MHz Frequency Band Plan [1]* and the *Australian Radiofrequency Spectrum Plan [2]*;
- the *1900-1920 MHz Frequency Band Plan [1]*, defines the regulatory relationships between BWA and point-to-point fixed services in the 1900-1920 MHz band. Nevertheless wherever possible licensees are encouraged to seek arrangements that facilitate the co-existence of BWA and pre-existing point-to-point fixed services;
- an ACMA assigner or Accredited Person will conduct the frequency coordination in accordance with this RALI. To satisfy themselves of the feasibility of the proposed BWA system applicants may undertake coordination studies in accordance with the procedures in this RALI prior to submitting the application. The results of such studies may be included with the licence application.

- remote stations are authorised to operate with a BWA base station on a ‘no interference no protection basis’, as detailed in the *Radiocommunications Licence Conditions (Fixed Licence) Determination 2015 [3]*.

1.3 Scope

The scope of the RALI extends to detailing the steps necessary for frequency coordination and licensing of proposed BWA systems. It covers frequency coordination between proposed BWA systems and other, previously licensed, BWA systems, and between proposed BWA systems and other radiocommunications services identified in Table 1 that share the same or adjacent bands.

This RALI aims to manage interference between systems to within limits defined in Attachment 2.

The RALI provides instructions that may be used by ACMA assigners and Accredited Persons when assessing whether proposed new BWA systems will cause (or receive) unacceptable interference to:

- existing BWA systems;
- point-to-point fixed links;
- PTS base station receivers;
- spectrum licensed space;
- fixed satellite service Earth Stations;
- the mid-west radio quiet zone;
- amateur services;
- radiolocation services; and
- other specific areas defined in Section 3.15

It is a requirement that coordination calculations should be performed to assess potential interference to and from the BWA system. In some cases the effect of remote stations¹ will need to be considered. Interference protection and requirements to protect other services are based upon the assumption that remote station deployments conform to the deployment model described in Attachment 3.

In the event that interference occurs after a licence is issued and the issue cannot be resolved between the affected parties, licensees can expect the ACMA to have regard to this RALI and relevant legislative instruments in dealing with the dispute. The ACMA will also pay particular attention to Annex 1 of Attachment 3 for licences issued in the 3575-3700 MHz band.

In the event that calculations indicate a likelihood of unacceptable interference, different processes apply according to the regulatory status of the service suffering the predicted unacceptable interference. As mentioned previously, for the 1900-1920 MHz band, in cases where potential unacceptable interference between the prospective BWA licensee and the point-to-point fixed link licensee is identified, it is intended that this should, in the first instance, trigger negotiation between the prospective BWA licensee and the point-to-point fixed link licensee.

¹ Various terms exist to describe the “remote stations” in a point-to-multipoint system. Examples include “subscriber terminals”, “outstations”, “subscriber modems”, “consumer premise equipment”, ‘subscriber station’. For the sake of consistency with regulatory terminology the term “remote stations” is used in this RALI.

This RALI does not address the coordination of point-to-point fixed services with other point-to-point fixed services. *RALI FX-3 Microwave Fixed Services Frequency Co-ordination [4]* is normally used for that purpose.

1.4 Overview of Coordination Procedures

Information on BWA equipment characteristics and an assumed deployment model are provided in Attachment 3. The deployment model provides assumed characteristics for the base station and for related remote stations. This RALI requires that coordination calculations should be performed to assess potential interference mainly to and from the BWA base station. In some cases however, remote stations will need to be considered in the coordination process.

Part 3 of this document describes a range of potential co-channel and adjacent channel interference mechanisms that should be considered when making assessments of potential interference.

Part 4 provides details of a procedure for performing assessments of potential interference. Attachment 2 provides the applicable protection criteria to be used in performing the assessments.

A summary of potential interference scenarios and the applicable coordination procedure is given in Table 1. Please note that not all interference scenarios are relevant for all bands covered by this RALI.

Interference mechanism	Coordination procedure	Affected Bands
BWA → BWA (see section 3.1)	Part 4 of this RALI	Both
BWA Tx → Point-to-point Rx (see section 3.2)	Part 4 of this RALI	Both
Point-to-point Tx → BWA Rx (see section 3.3)	Part 4 of this RALI	Both
PTS Tx → BWA Rx (see section 3.16)	RALI MS33	1900-1920 MHz
BWA Tx → spectrum licensed area (see section 3.4)	Attachment 4 of this RALI	1900-1920 MHz
spectrum licensed area → BWA Rx (see section 3.5)	No procedure required	1900-1920 MHz,
BWA Tx → DECT systems (see section 3.6)	No procedure required	1900-1920 MHz
DECT systems → BWA Rx (see section 3.6)	No procedure required	1900-1920 MHz
Point-to-point Tx → Point-to-point Rx	Outside scope of this RALI see RALI FX-3	-
BWA Tx → Earth Station Rx (see section 3.8)	Part 4 of this RALI	3575-3700 MHz
BWA Tx → Amateur Rx (see section 3.10)	No procedure required	3575-3700 MHz
Amateur Tx → BWA Rx (see section 3.9)	Part 4 of this RALI	3575-3700 MHz
BWA Tx → Radiolocation Rx (see section 3.14)	No procedure defined	3575-3700 MHz
Radiolocation Tx → BWA Rx (see section 3.13)	No procedure defined	3575-3700 MHz
BWA Tx → adjacent spectrum licensed band (see section 3.4)	Part 4 of this RALI	3575-3700 MHz
Adjacent spectrum licensed band → BWA Rx (see section 3.5)	Part 4 of this RALI	3575-3700 MHz
Coordination required with specific regional areas (see section 3.13)	Section 3.13 of this RALI	Both

Table 1: Summary of potential interference mechanisms

1.5 Licensing

All transmitters in a particular BWA system (comprising one base station and a number of remote stations communicating with that base station) are to be licensed under one Fixed licence authorising a Point-to-Multipoint station.

Licences will only be issued for BWA systems:

- in the 1900-1920 MHz band in those regional and remote areas of Australia that are outside the spectrum licensed areas defined in *Radiocommunications (Spectrum*

Re-allocation) Declaration No. 2 of 2000 [5]²;

- in the 3575-3700 MHz band in those regional and remote areas of Australia that are outside the areas defined in relevant embargoes contained in *RALI MS03 - Spectrum Embargoes [6]³*.

It should be noted that:

- in the 1900-1920 MHz band channel allotments of 5 MHz, 10 MHz and 20 MHz apply;
- in the 3.6 GHz band the channel arrangements as described in Figure 1 apply. Please note the 15 MHz and 30 MHz arrangements no longer apply for new licences. They are included as there are numerous existing services using these channels that may need to be coordinated against;
- for channels below 3680 MHz a 51 dBm/MHz EIRP density applies and for channel above 3680 MHz a 30 dBm/MHz EIRP density applies;

Additional information about the licensing arrangements is provided in Part 5 of this RALI.

² *These areas are illustrated in Attachment 1a*

³ *These areas are illustrated in Attachment 1b*

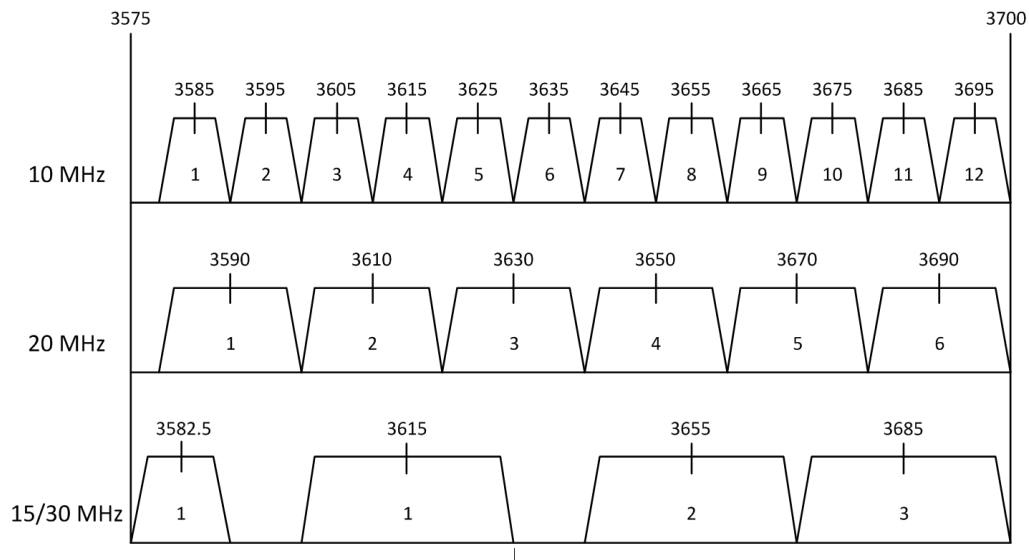


Figure 1. BWA channel plan for the 3.6 GHz band

* Please note the 15 MHz and 30 MHz arrangements no longer apply for new licences. They are included as there are numerous existing services using these channels that may need to be coordinated against.

Part 2: Background

2.1 Legislative/administrative arrangements: 1900-1920 MHz Band

In addition to the provisions of the *Australian Radiofrequency Spectrum Plan [2]*, the band 1900-1920 MHz is specifically addressed in two legal instruments that have effect in mutually exclusive geographic areas. These are:

- the *Radiocommunications (Spectrum Re-allocation) Declaration No. 2 of 2000 [5]* which, inter alia, covers the 1900-1920 MHz band in major metropolitan areas in all states and mainland territories. The re-allocation deadline date was 8 October 2002.

In metropolitan areas the available spectrum was, in most cases, allocated through a price based allocation process in 2001; and,

- the *1900-1920 MHz Frequency Band Plan [1]*, which applies to the 1900-1920 MHz band in regional and remote areas that are not included in the spectrum reallocation declaration;

Apparatus licensing arrangements in the 1900-1920 MHz band apply only in those areas that lie outside the areas set aside for spectrum licensing under the *Radiocommunications (Spectrum Re-allocation) Declaration No. 2 of 2000 [5]*. Apparatus licensing arrangements must also comply with the *1900-1920 MHz Frequency Band Plan [1]*. The objectives of that frequency band plan are to:

- promote the deployment of BWA by retaining the primary allocation for the mobile service and for the fixed service where used for point-to-multipoint applications in the 1900-1920 MHz band, and;
- give priority to BWA by demoting the regulatory status of the allocation for the fixed service where used for point-to-point applications from primary to secondary status in the 1900-1920 MHz band after 17 December 2005.

The frequency band plan establishes precedence for BWA systems but does this in such a way that pre-existing fixed point-to-point links need not be cleared unless they affect proposed BWA deployments.

Prior to the preparation of the frequency band plan, the 1900-1920 MHz spectrum was predominantly used (in regional and remote areas) for point-to-point fixed services. Two point-to-point fixed service bands, detailed in the 1.8 GHz and 2.1 GHz band channel arrangements of Appendix 1 of RALI FX-3, overlap in this frequency range. One main and two interleaved channels of the 1.8 GHz fixed band overlap the 1900-1920 MHz frequency band, as do the lowest main and interleaved channels of the 2.1 GHz fixed band. These relationships are illustrated in Figure 2.

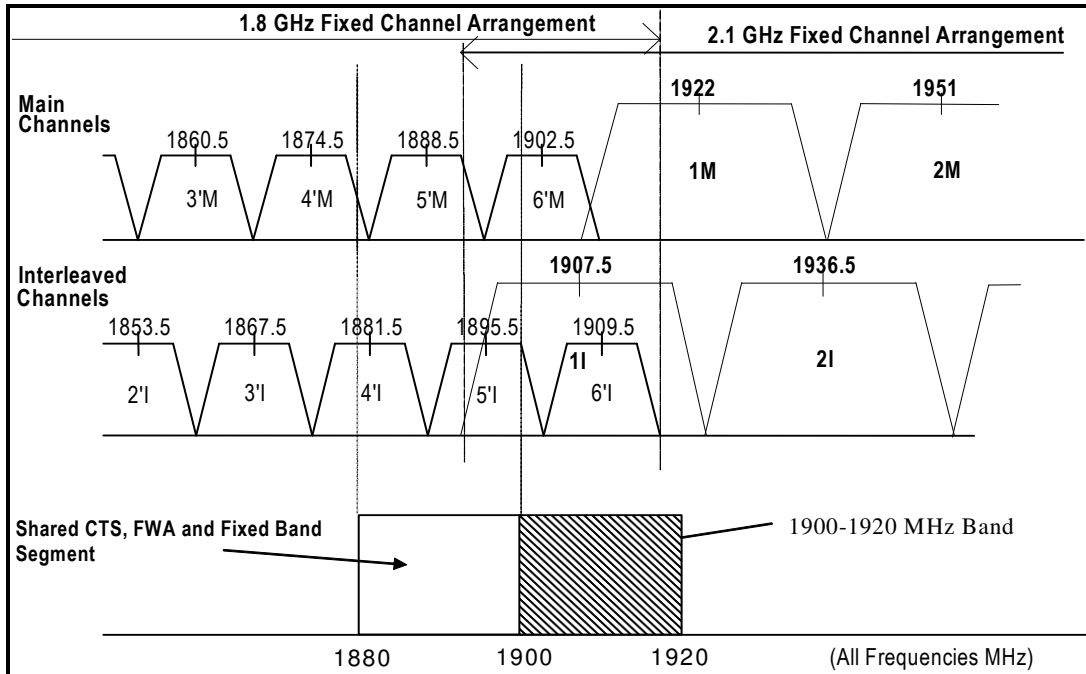


Figure 2: Relationships between the 1900-1920 MHz band and 1.8/2.1 GHz fixed channels

2.2 Legislative/administrative arrangements: 3575-3700 MHz Band

In addition to provisions of the *Australian Radiofrequency Spectrum Plan* [2], the band 3575-3700 MHz is also addressed in the following legal instruments:

- The *Radiocommunications Licence Conditions (Amateur Licence) Determination No. 1 of 1997* [7] which allows amateur services restricted use of the 3575-3600 MHz band on a secondary basis;
- The *Radiocommunications Licence Conditions (Fixed Licence) Determination* [3], which specifies particular technical requirements for point-to-multipoint licences in this band.

Apparatus licensing arrangements in the 3575-3700 MHz band only apply in those areas that lie outside relevant embargo areas defined in *RALI MS03 – Spectrum Embargoes* [6].

The *Australian Radiofrequency Spectrum Plan* [2] allows for the existence of BWA with:

- Satellite Earth Stations in the 3600-3700 MHz band on a co-primary basis;
- Point-to-point links in the 3590-3700 MHz⁴ band on a co-primary basis;
- Amateur radio (secondary service) in the 3575-3600 MHz band; and
- Radiolocation services in the 3575-3600 MHz band on a co-primary basis.

⁴ Channel plan as defined in *RALI FX3*

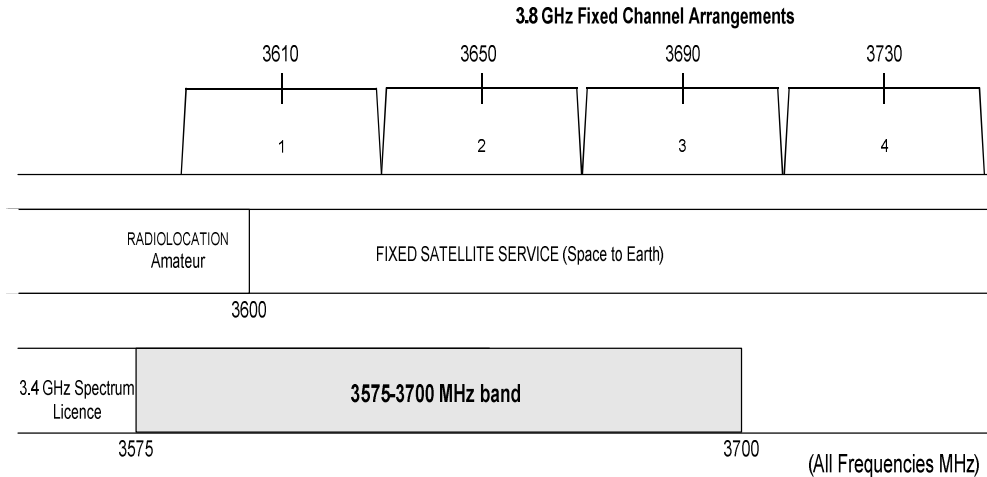


Figure 4: Relationships between the 3575-3700 MHz band and the 3.8 GHz fixed channels, FSS allocations, Radiolocation allocations, Amateur allocations and 3.4 GHz spectrum licence space

New BWA systems cannot be licensed if coordination or a mutual agreement with other existing primary services cannot be effected.

Amateur radio services are permitted the restricted use of the 3575-3600 MHz band as described in the *Radiocommunications Licence Conditions (Amateur Licence) Determination [7]*. A condition of their use is that operation must not cause harmful interference to and cannot claim protection from licensed primary radiocommunications devices.

The 3575-3700 MHz band overlaps three channels of the 3.8 GHz band fixed point-to-point channel arrangements. The channels affected cover the frequency band 3590-3710 MHz.

Part 3: Potential interference mechanisms

3.1 BWA into BWA

3.1.1 Cochannel frequency coordination

Frequency coordination procedures for assessing whether a proposed new BWA base station will cause (or suffer) unacceptable interference to (or from) previously licensed BWA base station receivers are detailed in Part 4 of this document. These procedures deal only with the coordination of cochannel BWA base stations. The coordination of adjacent channel BWA base stations is not required for the assignment of new BWA base stations. Issues relating to the operation of base stations using adjacent channels are considered in Section 3.1.2

3.1.2 Adjacent channel considerations

The case of adjacent channel interference needs to be carefully considered. In particular, if TDD technology is used in an uncontrolled manner, then adjacent channel transmitters and receivers could operate at the same time on immediately adjacent channels. This scenario is highly likely to cause adjacent channel interference, but it is not necessarily inevitable. However, it places significant demands on site engineering and co-operation between the adjacent channel licensees if interference is to be avoided.

The most straightforward method of avoiding risk of adjacent channel interference is for adjacent channel licensees to operate their base station equipment such that the transmitters and receivers are synchronised. In theory at least, a wide range of techniques (or more probably combinations of techniques) might also be able to achieve necessary levels of transmitter-to-receiver isolation. These could include: use of very tightly specified transmitter and receiver filtering; guard bands; where multi-carrier modulation systems are used switching off carriers; and/or, careful site engineering to minimise transmitter to receiver coupling at common sites. One reference suggests that the required level of transmit-to-receive isolation is in excess of 72 dB⁵.

Because of the difficulty of achieving this level of isolation, the ACMA's preference is that the synchronisation approach be followed. But if other approaches are followed the ACMA intends to encourage licensees to cooperate and, where necessary, equally compromise to resolve any adjacent channel interference. This approach recognises that with TDD systems the interference risk is “bi-directional” and will fall on both adjacent channel licensees.

The adjacent channel interference risk management principles outlined above are captured in the *Radiocommunications Licence Conditions (Fixed Licence) Determination [3]*. The conditions contained in this determination require that:

- No harmful adjacent channel interference shall be caused to base station receivers operating in accordance with Radiocommunications Assignment and Licensing Instruction FX 19.
- Protection from harmful adjacent channel interference caused by base stations operating in accordance with Radiocommunications Assignment and

⁵ refer ETSI TS 125 105 6.0.0 (2003-12), Table 6.8.

Licensing Instruction FX 19 is not afforded.

It is noted that compliance with this licence condition will be considered to be satisfied where, in response to such interference:

- affected licensees align their transmit/receive timing to avoid interference; or
- such other measures as may be agreed by affected licensees.

3.2 BWA transmitter into fixed link receiver

As mentioned earlier, a consequence of the BWA deployment model is that BWA base station transmitters will be the element of the BWA system most likely to cause potential interference to incumbent point-to-point fixed service receivers.

For the 1900-1920 MHz band, interference mechanisms between BWA base transmitters and point-to-point fixed service receivers in the 1.8 GHz band arrangements and the 2.1 GHz band arrangements should be assessed.

For the 3575-3700 MHz band, interference mechanisms between BWA base transmitters and point-to-point fixed service receivers in the 3.8 GHz band arrangements should be assessed.

Frequency coordination procedures for assessing whether a proposed new BWA base station transmitter will cause unacceptable interference to previously licensed point-to-point fixed service receivers should be performed according to the frequency coordination process outlined in Part 4.

For the 3575-3700 MHz band, in the event that calculations indicate that interference may occur, unless an agreement or other arrangements can be made between the BWA applicant and the point-to-point licensee, a licence will not be granted.

For the 1900-1920 MHz band, in the event that calculations indicate that interference may occur, the ACMA would issue a dated “notice of predicted interference”⁶. That notice will be sent to the affected point-to-point fixed service licensee and also copied to the BWA applicant.

The “notice of predicted interference” will:

- advise the incumbent point-to-point fixed service licensee of the details of the apparatus licence issued to the BWA applicant;
- advise the incumbent licensee of the predicted interference;
- remind the incumbent point-to-point fixed service licensee that, from 17 December 2005, point-to-point fixed services in the band have secondary status and BWA services have primary status;
- remind the incumbent point-to-point fixed service licensee that, from 17 December 2005, the status of services requires that a point-to-point fixed service shall not cause interference to a primary service and cannot claim protection from interference from a primary service; and
- encourage the point-to-point fixed service licensee to establish a dialogue with the

⁶ Where licence applications are submitted to the ACMA by Accredited Persons, the Accredited Person shall include any necessary recommendations to the ACMA concerning the need to issue a “notice of predicted interference”.

new BWA licensee to identify (a) the likely commencement time of the new BWA service and (b) arrangements which will be made by the point-to-point fixed service licensee for the avoidance of interference.

The *1900-1920 MHz Frequency Band Plan [1]* sets a status priority between BWA and point-to-point fixed services that can be used to settle disputes. However, it is desirable that both parties negotiate on these issues and only use the Band Plan as a last resort. In many cases this could allow the introduction of the BWA service while allowing the continued operation of point-to-point fixed links.

Arrangements to deal with interference might include:

- point-to-point fixed link licensee agreeing to accept the interference. (Many point-to-point fixed links operate with considerable excess fade margin. It is highly likely that reducing the excess fade margin of such links would have little or no practical impact on fixed link operation. If an agreement to operate with a reduced fade margin is made the licence of the affected point-to-point fixed link licensee would be amended to add a special condition to indicate this agreement);
- point-to-point fixed link licensee installing a filtering system, more directional antennas, re-siting antennas or other measures to reduce the predicted interference to an acceptable level. (The licence of the affected point-to-point fixed link licensee might need to be appropriately amended if changes affecting frequency coordination parameters are made).

Alternatively, the point-to-point fixed link licensee might wish to negotiate with the BWA licensee for:

- different siting of the BWA antenna;
- selecting a different radiation pattern for a sectored antenna BWA site.

Note that these actions would require the BWA application and/or the point-to-point link to be reassessed against the relevant coordination criteria.

In the event that an agreement to deal with the predicted interference cannot be achieved, under the terms of the *1900-1920 MHz Frequency Band Plan [1]*, after 17 December 2005, the potentially affected point-to-point fixed service licensee will need to vacate the frequency.

3.3 Fixed link transmitter to BWA receiver

For the 1900-1920 MHz band, interference mechanisms between BWA base station receivers and point-to-point fixed service transmitters in the 1.8 GHz band arrangements and the 2.1 GHz band arrangements should be assessed.

For the 3575-3700 MHz band, interference mechanisms between BWA base receivers and point-to-point fixed service transmitters in the 3.8 GHz band arrangements should be assessed.

Frequency coordination procedures for assessing whether a proposed new BWA base station receiver will receive unacceptable interference from previously licensed fixed point-to-point fixed service transmitters should be performed according to the frequency coordination process outlined in Part 4.

For the 3575-3700 MHz band, in the event that calculations indicate that interference may occur, unless an agreement or other arrangements can be made between the

BWA applicant and the point-to-point licensee, a licence will not be granted.

For the 1900-1920 MHz bands in the event that calculations indicate that interference may occur, the ACMA would issue a dated “notice of predicted interference”⁶. That notice will be sent to the affected point-to-point fixed service licensee and also copied to the BWA applicant.

The “notice of predicted interference” will:

- advise the incumbent point-to-point fixed service licensee of the details of the apparatus licence issued to the BWA applicant;
- advise the incumbent licensee of the predicted interference;
- remind the incumbent point-to-point fixed service licensee that, from 17 December 2005, point-to-point fixed services in the band have secondary status and BWA services have primary status;
- remind the incumbent point-to-point fixed service licensee that, from 17 December 2005, the status of services requires that a point-to-point fixed service shall not cause interference to a primary service and cannot claim protection from interference from a primary service; and,
- encourage the point-to-point fixed service licensee to establish a dialogue with the new BWA licensee to identify (a) the likely commencement time of the new BWA service and (b) arrangements which will be made by the point-to-point fixed service licensee for the avoidance of interference.

The *1900-1920 MHz Frequency Band Plan [1]* sets a status priority between BWA and point-to-point fixed services that can be used to settle disputes. However it is desirable that both parties negotiate and use the Band Plan as a last resort. In many cases this could allow the introduction of the BWA service while allowing continued operation of the point-to-point fixed links.

Arrangements to deal with interference might include:

- BWA licensee agreeing to accept the interference (the BWA licence would need to have a special condition added to indicate this agreement);
- BWA licensee installing a filtering system, more directional antennas, locating the BWA receiver at a different site or other measures to reduce the predicted interference to an acceptable level. (The BWA licence will need to reflect the frequency coordination parameters that are finally agreed).

Alternatively, the point-to-point fixed link licensee might wish to:

- install a filtering system, more directional antennas, re-site the point-to-point fixed link antenna or other measures to reduce the predicted interference to an acceptable level. (The point-to-point fixed licence will need to reflect the frequency coordination parameters that are finally agreed);
 - negotiate with the BWA licensee to select a different radiation pattern for a sectored antenna BWA site.

Note that these actions would require the BWA application and/or the point-to-point link to be reassessed against the relevant coordination criteria.

In the event that an agreement to deal with the predicted interference cannot be achieved, under the terms of the *1900-1920 MHz Frequency Band Plan [1]*, after 17

December 2005, the potentially affected point-to-point fixed service licensee will need to vacate the frequency.

3.4 BWA transmitter into Spectrum Licensed Space

3.4.1 Adjacent Area Coordination

A BWA transmitter located near a spectrum licence boundary has the potential to cause interference to receivers within the spectrum licensed area.

A BWA transmitter requiring coordination with a spectrum licence needs to coordinate with a “spectrum space” as opposed to traditional coordination that is undertaken with respect to other radiocommunications devices at specific locations. Therefore, spectrum licence coordination principles need to be applied when co-ordinating BWA transmitters with spectrum licences.

To protect a spectrum licence from a proposed BWA transmitter, the BWA transmitter should be treated as though it were spectrum licensed. That is, the proposed BWA transmitter will be considered to not interfere with the spectrum licence if the device boundary (a polygon) of the BWA transmitter does not intrude into the co-channel spectrum licensed area. The device boundary criterion and the method to determine the device boundary polygon are specified in Attachment 4. Adjacent area coordination will need to be considered for both the 1900-1920 MHz and 3575-3700 MHz bands.

Note that only coordination of a BWA base station with a spectrum licensed area is required. It is believed that this will also adequately satisfy coordination requirements for any associated mobile stations, due to the significant difference in EIRP’s and antenna heights of the stations.

3.4.2 Adjacent Band Coordination

The case of adjacent channel interference between spectrum licensed receivers and BWA transmitters needs also to be considered. In particular, if TDD technology is used in an uncontrolled manner or FDD equipment is deployed in the adjacent spectrum licensed space, then adjacent channel transmitters and receivers could operate at the same time on adjacent channels. This scenario can cause adjacent channel interference, but it is not necessarily inevitable. Currently adjacent band coordination needs to be considered for BWA devices that operate in the 3575-3700 MHz frequency range.

Interference from Apparatus licensed transmitters into devices operated under spectrum licences is managed by advisory guidelines. See the *3.4 GHz Spectrum Licence Technical Framework – Guidelines [8]*.

This guideline specifies compatibility requirements between spectrum licensed services and apparatus licensed services. The compatibility requirements are a model on the basis of which spectrum and apparatus licensees are expected to develop co-ordination procedures for the management of interference to each other’s services, using good engineering practice.

Frequency coordination procedures for assessing whether a proposed new BWA base station transmitter will cause unacceptable interference to a previously registered spectrum licence receiver are outlined in Part 4.

The ACMA encourages adjacent band licensees to cooperate and, where necessary,

compromise to resolve any adjacent channel interference. Possible approaches to this are described in section 3.1.2. The ACMA is also prepared to consider alternative interference management arrangements agreed between spectrum licensees and apparatus licensees.

In cases where agreement cannot be made or is not practical due to the technologies being deployed, coordination is to be carried out on a first in time basis. This means that proposed new licences must not cause harmful interference to existing licences, regardless of whether licences were issued under this RALI or through device registration in a spectrum licence space.

Although coordination procedures offer some inherent protection to spectrum licensed devices from adjacent band remote stations, protection from harmful interference cannot be guaranteed from this procedure alone. In order to account for the interference potential from remote stations and protect registered receivers operating in a spectrum licensed space, the *Radiocommunications Licence Conditions (Fixed Licence) Determination [3]* requires that no harmful interference be caused to registered receivers in a spectrum licensed space.

3.5 Spectrum Licensed Device into BWA receiver

3.5.1 Adjacent Area Coordination

A BWA receiver located near a spectrum licence boundary has the potential to receive interference from transmitters located within the spectrum licensed area. In most situations however, there will be a high level of reciprocity between the potential interference to a BWA receiver from transmitters located within the spectrum licensed area and the potential interference that a BWA transmitter may cause to receivers located within the spectrum licensed area. There are expected to be very few situations where a BWA transmitter could be licensed but where an associated BWA receiver would suffer interference.

For this reason it is considered sufficient to formally assess potential interference from a BWA transmitter into the spectrum licensed area but to rely on a licence condition to deal with the unusual/unlikely instance where a BWA transmitter could be licensed but an associated BWA receiver may suffer interference. Licensees would of course be free to undertake their own assessment of potential interference risk to BWA receivers.

3.5.2 Adjacent Band Coordination

The case of adjacent channel interference between spectrum licensed transmitters and BWA receivers needs to also be considered. In particular, if TDD technology is used in an uncontrolled manner or FDD equipment is deployed in the adjacent spectrum licensed space, then transmitters and receivers could operate at the same time on adjacent channels. This scenario is highly likely to cause adjacent channel interference, but it is not necessarily inevitable. Adjacent band coordination needs to be considered for BWA services operating in the 3575-3700 MHz frequency range.

Interference from devices registered for operation in a spectrum licensed space into apparatus licensed receivers is managed by advisory guidelines. See the 3.4 GHz Spectrum Licence Technical Framework – Guidelines [8].

This guideline specifies compatibility requirements between spectrum licensed services and apparatus licensed services. The compatibility requirements are a model

on the basis of which spectrum and apparatus licensees are expected to develop co-ordination procedures for the management of interference to each other's services, using good engineering practice. For 3.4 GHz spectrum licensed devices, compatibility requirements for BWA receivers are those specified in attachments 2a of this RALI.

Frequency coordination procedures for assessing whether a proposed new BWA base station receiver will receive unacceptable interference from a previously registered spectrum licence transmitter are outlined in Part 4.

The ACMA encourages adjacent band licensees to cooperate and, where necessary, compromise to resolve any adjacent channel interference. Possible approaches to this are described in section 3.1.2. The ACMA is also prepared to consider alternative interference management arrangements agreed between spectrum licensees and apparatus licensees.

In cases where agreement cannot be made or is not practical due to the technologies being deployed, coordination is to be carried out on a first in time basis. This means that proposed new licences must not cause harmful interference to existing licences, whether licences were issued under this RALI or through device registration in a spectrum licence space.

Although coordination procedures offer some inherent protection to remote stations, explicit protection is not afforded.

3.6 1880-1900 MHz band: DECT systems

Spectrum in the 1880-1900 MHz band is used by class licensed DECT cordless telephone services that may operate in all parts of Australia. In defined remote and rural areas apparatus licensed FWA services using DECT technology may also be licensed. These services have a lower adjacent relationship with the 1900-1920 MHz band.

Interference to adjacent band class licensed DECT cordless telephones (or Apparatus Licensed point-to-multipoint systems using DECT technology licensed under RALI FX-18 arrangements) could potentially occur in situations where the DECT equipment and 1900-1920 MHz band BWA equipment are located in close proximity. However, in practice it is expected that the operation of the DECT technology will mitigate the potential interference risks. DECT technology incorporates a Dynamic Channel Assignment algorithm whereby when a DECT receiver senses interference above a threshold level on a particular channel the DECT system will seek an alternative less interference prone channel.

In the case of BWA base stations and the DECT handsets or DECT base ("land") stations the interference risk is expected to be low because the DECT equipment will generally be operated indoors and in the event that the DECT system detects an interfering signal the Dynamic Channel Assignment system will operate to move the system to an alternate channel.

In the case of BWA remote stations and the DECT handsets or DECT base ("land") stations there is a higher level of potential interference because DECT equipment and BWA remote stations could be located in close proximity inside buildings. This potential interference risk is minimised/managed by the following considerations:

Dynamic Channel Assignment would in most situations mean that the DECT

system would shift its operating frequency away from the potential interference;

As detailed in section 4.13.1, BWA point-to-multipoint fixed assignments would be attempted first on the channel(s) furthest from the 1880-1900 MHz band;

Because of the difficulty of controlling the proximity of DECT and BWA equipment in domestic and office situations, BWA receivers operating in the 1900-1920 MHz band will not be afforded protection in the event that interference is caused by DECT equipment.

3.7 1920-1935 MHz band: Spectrum licensed services

The 1920-1980 MHz band has an upper adjacent relationship with the 1900-1920 MHz band and is subject to *Radiocommunications (Spectrum Re-allocation) Declaration [5]*. That declaration re-allocated the 1920-1980 MHz band in the major metropolitan cities of each State and the Northern Territory for spectrum licensing. In Canberra the re-allocation declaration covered the frequency range 1935-1980 MHz, while in the Eastern and Western Regional areas (which cover the remainder of the more populous parts of Australia) the re-allocated frequency range was 1960-1980 MHz.

	1900-1920 MHz	1920-1935 MHz
Sydney	SL	SL
Melbourne	SL	SL
Brisbane	SL	SL
Perth	SL	SL
Adelaide	SL	SL
Hobart	SL	SL
Darwin	SL	SL
Canberra	SL	AL
Eastern regional	AL	AL
Western regional	AL	AL

Table 2: Geographic Summary of Spectrum licensing and Apparatus licensing

Table 2 shows that there are no areas where an apparatus licensed 1900-1920 MHz band BWA service is frequency adjacent to a “same area” spectrum licence in the 1920-1935 MHz band. Therefore no specific attention has been given to potential adjacent channel interference between 1900-1920 MHz band apparatus licensed BWA services and 1920-1935 MHz band spectrum licensed services.

3.8 3600-4200 MHz Band: BWA Transmitters into FSS

The band 3600-4200 MHz has allocations to the Fixed Satellite Service (FSS) for Space-to-Earth communications. The band has a co-channel and an adjacent channel relationship with the 3575-3700 MHz band.

There are three potential interference mechanisms:

- Co-channel interference from BWA transmitters (base stations or remote stations) operating in the 3600-3700 MHz frequency range;
- Adjacent channel interference from BWA transmitters (base stations or remote stations) in the 3575-3700 MHz frequency range into FSS receivers located in the 3600-4200 MHz band; and,
- Interference caused by a receiver being driven into non-linear operation caused by transmissions from BWA transmitters (base stations or remote stations) operating in the 3575-3700 MHz frequency range into FSS Earth Stations located in the 3600-4200 MHz band.

Frequency coordination procedures for assessing whether a proposed new BWA base station transmitter will cause unacceptable interference to licensed FSS receivers should be performed according to the frequency coordination process outlined in Part 4. Further guidance is also given in Attachment 5.

In most cases successful coordination between a BWA base stations and an earth station, implies that interference from remote stations will also be addressed. However, in order to account for situations outside of the BWA system deployment model assumed in attachment 3, a condition of ‘no interference no protection’ on remote stations is applied. This condition is captured in the *Radiocommunications Licence Conditions (Fixed Licence) Determination [3]*. Other deployment restrictions also apply for WAS remote stations operating in the 3575-3700 MHz band.

3.9 3575-3600 MHz Band: Amateur Service into BWA

The band 3575-3600 MHz has a secondary allocation to Amateur Service throughout Australia. The *Radiocommunications Licence Conditions (Amateur Licence) Determination [7]* allows the Amateur Repeater and the Amateur Advanced license options to operate in this frequency band. The *Australian Radiofrequency Spectrum Plan [2]* sets a secondary status for Amateur services in the 3575-3600 MHz band. This status means that incumbent amateur services must avoid causing interference to a primary service and cannot claim protection from interference from a primary service.

In the case of interference from amateur advanced transmitters into BWA receivers, no coordination criteria has been developed. The reasons for this are:

- the actual interference risk is considered to be low due to low density use of the 3575-3600 MHz band by this service, the mobile/nomadic nature of the service, and the expected main use of this service in major city areas which are located inside embargo areas⁷;
- amateur advanced licences have secondary status in the band, therefore a condition of use is that amateur licensees take reasonable steps to ensure they do not cause harmful interference to BWA receivers.

In the case of interference from amateur repeater transmitters into BWA receivers, coordination should be performed according to the frequency coordination process outlined in Part 4. For the 3575 - 3700 MHz band, in the event that calculations indicate that interference may occur, the ACMA would issue a dated “notice of

⁷ See embargo 42 of RALI MS3

predicted interference”. That notice will be sent to the affected Amateur service licensee and also copied to the BWA applicant.

The “notice of predicted interference” will:

- advise the incumbent amateur service licensee of the details of the apparatus licence issued to the BWA applicant;
- advise the incumbent licensee of the predicted interference;
- remind the incumbent amateur service licensee that amateur services in the band have secondary status and BWA services have primary status;
- remind the incumbent amateur service licensee that the status of services requires that an amateur service must avoid causing interference to a primary service and cannot claim protection from interference from a primary service; and,
- encourage the amateur service licensee to establish a dialogue with the new BWA licensee to identify (a) the likely commencement time of the new BWA service and (b) arrangements which will be made by the amateur service licensee for the avoidance of interference.

The *Australian Radiofrequency Spectrum Plan [2]* sets a status priority between BWA and amateur services that can be used to settle disputes. However it is desirable that both parties negotiate and use the status priority as a last resort. In many cases this could allow the introduction of the BWA service while allowing continued operation of Amateur services. A number of possible arrangements to deal with interference are described in section 3.2.

In the event that an agreement to deal with the predicted interference cannot be achieved, under the terms of the *Australian Radiofrequency Spectrum Plan [2]*, the affected amateur service licensee will need to vacate the frequency.

3.10 3575-3600 MHz Band: BWA into Amateur Service

The band 3575-3600 MHz has a secondary allocation to Amateur Service throughout Australia. The *Radiocommunications Licence Conditions (Amateur Licence) Determination [7]* allows the Amateur Repeater and the Amateur Advanced licence options to operate in this frequency band. The *Australian Radiofrequency Spectrum Plan [2]* sets a secondary status for Amateur services in the 3575-3600 MHz band. This status means that incumbent amateur services must avoid causing interference to a primary service and cannot claim protection from interference from a primary service.

In the case of interference to amateur advanced receivers from BWA transmitters, no coordination procedure has been defined. The reasons for this are:

- the actual interference risk is considered to be low due to low density use of the 3575-3600 MHz band by this service, the mobile/nomadic nature of the service, and the expected main use of this service in major city areas which are located inside embargo areas;
- amateur advanced licences have secondary status in the band and therefore cannot claim protection from interference.

In the case of interference to apparatus licensed amateur repeater receivers from BWA transmitters, no coordination procedure has been defined. The reasons for this are:

- use of the band by amateur repeaters is low;
- successful coordination of amateur repeater transmitters with BWA receivers is considered sufficient to offer an adequate level of protection to amateur repeater receivers;
- amateur repeaters have secondary status in the band and therefore cannot claim protection from interference.

In the event that interference occurs from a deployed BWA transmitter into an amateur service receiver, it is desirable that both parties establish a dialogue with the aim to coexist without interference. This may in some cases, facilitate the use of the band by both BWA and amateur services.

In the event that an agreement to deal with interference cannot be achieved, under the terms of the *Australian Radiofrequency Spectrum Plan [2]*, the affected amateur service licensee can choose to either accept the interference or vacate the frequency.

3.11 3400-3600 MHz Band: Radiolocation into BWA

In order to assess the potential effect Radiolocation services may have on WAS deployments and the need for coordination criteria, the ACMA initiated a dialogue with the Department of Defence (DoD) on their current and planned use in the 3400-3600 MHz band. Information currently available indicates that WAS deployments in the 3.6 GHz band will neither severely affect or be severely affected by these radiolocation services, and the potential for interference will be low and transient in nature and therefore manageable. The ACMA will continue to consult on and monitor this issue with DoD in the future.

3.12 3400-3600 MHz Band: BWA into Radiolocation

It is expected that the worst case interference will be from Radiolocation services interfering with BWA receivers and that if conditions are satisfied for this case, the reverse case of BWA transmitters interfering into Radiolocation receivers will be met. Since current information suggest that the potential for interference from Radiolocation services into BWA receivers is low and transitory in nature, it is considered that coordination is not required for the reverse scenario.

3.13 Coordination with specific regional areas

Mid-West Radio Quiet Zone

The ACMA established Australia's first Radio Quiet Zone (RQZ) on 11 April 2005. The RQZ aims to maintain the current "radio-quietness" of a site in remote Western Australia (near Boolardy Station, around 200 km East of Meekatharra). The area has very low levels of radiofrequency energy because of its low population and lack of industrial development. The RQZ is intended to facilitate the development and use of new radio astronomy technologies at that location, and support Australia's bid to host the Square Kilometre Array (SKA).

On 24 September 2006, the ACMA released a *RALI MS32, Coordination of Apparatus Licences within The Australian Radio Quiet Zone Western Australia [9]*. The RALI defines the RQZ as inner restricted zones where new frequency assignments are not usually permitted (with exceptions assessed on a case by case

basis), and outer coordination zones within which new frequency assignments require coordination. The frequency span of the RQZ is 100 MHz to 25.25 GHz. RALI MS32 contains the relevant procedures and criteria required in order to coordinate with the RQZ.

A summary of the restricted and coordination zones for the frequency bands 1900-1920 MHz and 3575-3700 MHz is given Table 3. No new assignments are to be made within the restricted zones. If a proposed assignment lies within a coordination zone then a coordination procedures outlined in RALI MS32 must be followed [15].

Frequency Range (MHz)	Restricted Zone Radius (km)	Coordination Zone Radius (km)
1900-1920	100	140
3575-3700	100	120

Table 3: RQZ Coordination and Exclusion zone radii. The RQZ is centred at latitude 26°42'15" South and longitude 116°39'32" East (GDA94 Datum) .

Darwin and Geraldton Coordination Zones

Requests for assignments in the 3575-3700 MHz band within 150 km of latitude 12°26'59" South and longitude 130°50'0" East (GDA94 Datum) in Darwin (NT) and latitude 28°45'59" South and longitude 114°37'0" East (GDA94 Datum) in Geraldton (WA), are to be referred to the Manager, Spectrum Engineering Section, Spectrum Planning Branch, Canberra Central Office, ACMA, for preliminary coordination consultation⁸.

The Woomera Prohibited Area (WPA)

Requests for assignments inside and within 100 km of the Woomera Prohibited Area (WPA), as defined in embargo 52⁹, are to be referred to the Manager, Spectrum Engineering Section, Spectrum Planning Branch, Canberra Central Office, ACMA, for preliminary coordination consultation.

Once an application is received, the Manager of Spectrum Engineering will refer the application to the Department of Defence (Defence). It is intended that this process will:

- provide Defence with notification of the intended application;
- open a dialogue between the ACMA and Defence regarding the application and any advice Defence may have regarding compatibility with their operations; and

⁸ ACMA file F1989-207, held by Manager, Spectrum Planning Engineering Section, Spectrum Planning Branch, refers.

⁹ Embargo 52 applies to the 3600-3700 MHz frequency range inside the WPA; this means operators only have access to the 3575-3600 MHz portion of the 3.6 GHz band inside the WPA.

- allow Defence to gain more detailed characteristics of the application to better affect coordination for activities within the WPA.

Defence will be given a 2 week period to consider the application and provide advice to the ACMA. The ACMA will consider this advice before making a decision on whether the application will be accepted, refused or requires modification.

The ACMA will also attach an advisory note to all WAS licences issued inside and within 100 km of the WPA advising licensees that they may receive interference from the Department of Defence operations in the WPA. In conjunction with this advisory note, the ACMA will also require the Department of Defence to take reasonable measures to limit or avoid causing interference to licensed services inside and within 100 km of the WPA.

Details of the advisory note can be found in section 5.2.2.

3.14 1920-1980 MHz Band: BWA Tx into PTS Rx

RALI MS33 "Frequency Coordination and Licensing Procedures for Apparatus Licensed PTS in the 2 GHz Bands" [10] contains conditions that support the provision of Public Telecommunications Services (PTS) in regional and remote areas of Australia in the 1920-1980 and 2110-2170 MHz bands.

A BWA base station transmitter operating in the 1900-1920 MHz band has the potential to cause interference to an adjacent channel PTS base station receiver operating in the 1920-1980 MHz band. This is due to the different duplex schemes utilised. Frequency coordination procedures for assessing whether a BWA base station transmitter will cause unacceptable interference to a PTS base station receiver are detailed in RALI MS33.

Other interference mechanisms related to BWA remote station transmitters and receivers as well as PTS mobile station transmitters are largely covered by the coordination of BWA and PTS base stations and the respective assignment planning models.

However, in the event that interference does occur the ACMA encourages licensees to cooperate and, where necessary, compromise to find a resolution. If the matter cannot be resolved between affected parties, it is noted that BWA remote stations and PTS mobile stations operate on a 'no interference no protection' basis. Licensees will therefore be required to rectify any interference issues into base station receivers caused by these devices.

Part 4: BWA Coordination Procedure

4.1 Overview of Coordination Procedure

This part provides an overview of the coordination procedure to be followed.

To perform the coordination, access to licence data for existing assignments is required. This data is available on the ACMA's Register of Radiocommunications Licences (RRL) which is available for purchase on CD-ROM.

The basic coordination procedure described here aims to minimise the number of situations requiring close analysis by eliminating as many potential coordination cases from consideration as possible using simple, conservative, calculation methods (stage 1). If, after this, cases remain for which potential unacceptable interference is identified then assumptions can be refined and more detailed information and propagation models can be used (stage 2). For typical coordination assessments the steps outlined below (or relevant parts thereof) need to be completed.

A separate procedure is identified in attachment 4 for coordination of BWA with Spectrum Licence Areas.

Stage 1:

- Step 1. Identify potentially affected receivers and potentially interfering transmitters;
- Step 2. Determine the path length for the wanted and unwanted (interference) paths for each identified potential victim receiver;
- Step 3. Determine the antenna discrimination between the proposed system and each identified victim receiver, and each identified interfering transmitter;
- Step 4. Calculate propagation losses for the unwanted paths using a simple method (free space propagation model);
- Step 5. Calculate propagation losses for the wanted path using a simple method (free space propagation model);
- Step 6. Determine the wanted power at each receiver from its transmitter;
- Step 7. Determine the unwanted power at each receiver from the proposed transmitter and the unwanted power at the proposed receiver from each identified potential interfering transmitter.
- Step 8. Determine the required protection criteria for each identified victim receiver;
- Step 9. Compare the calculated level or wanted-to-unwanted ratio for each receiver against the applicable protection criteria; and, if required

Stage 2:

- Step 10 Re-calculate propagation losses using alternative propagation model(s) possibly including more sophisticated models using terrain database information; and,
- Step 11 Repeat steps 7 through 9.

4.2 Detailed description of Coordination Procedure

Stage 1

Step 1: Identify potentially affected receivers and interfering transmitters

The first step is to identify all receivers that may be affected by the operation of the proposed new system. Only those receivers operating within a frequency cull range and located within a distance cull radius need to be considered. If no potential victim

receivers are identified within the frequency and distance cull ranges then no further coordination calculations are required.

To assess the effects of other systems into a proposed system it is also necessary to identify all transmitters falling within specified frequency and distance cull limits.

Step 2: Determine wanted and unwanted path lengths for each potential victim receiver

Step 2 of the coordination procedure can be split into two cases:

Case 1 - interference from a proposed new system

In the case of point-to-point links, the wanted paths will be the transmit-to-receive pairs identified in Step 1, which may be affected by the proposed transmitter.

The unwanted path is from the proposed transmitter into potential victim receivers.

Case 2 - interference to a proposed new system

The unwanted paths are from transmitters identified within Step 1 into a proposed receiver.

The path lengths of the unwanted and wanted paths are required for calculation of propagation losses in later steps.

Step 3: Determine the discrimination between services

In Step 3 of the coordination procedure the discrimination angle (azimuth) between the wanted path and each unwanted path is determined. Figure 5 illustrates this requirement.

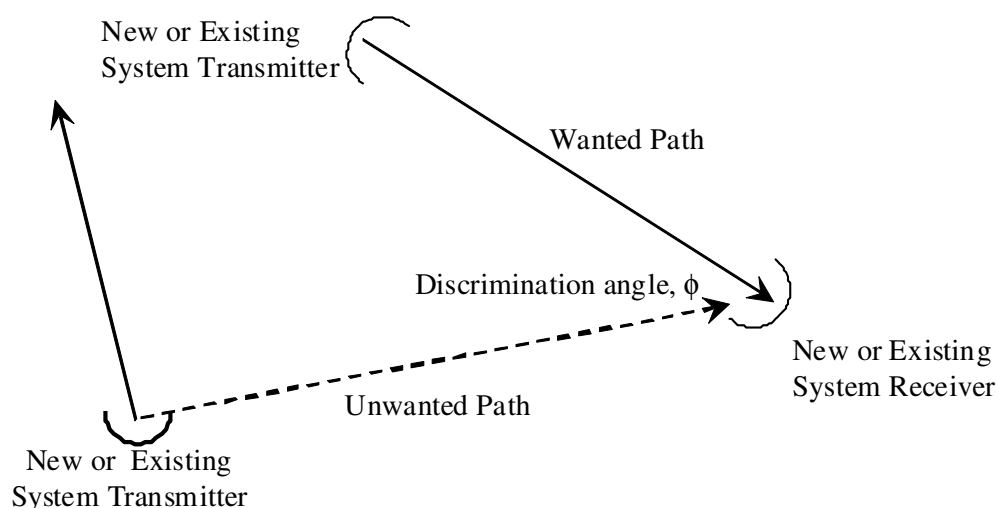


Figure 5. Discrimination angle between a wanted and an unwanted path

The discrimination angle is used to determine the antenna discrimination from the corresponding antenna radiation pattern envelope (RPE). In accordance with Appendix 11 of RALI FX-3, wherever possible, actual antenna RPEs for all relevant transmitters and receivers should be used when determining the antenna discrimination at the relevant angle.

Step 4: Calculate free space propagation losses for unwanted paths

Step 4 of the coordination procedure is to calculate the propagation loss between each transmitter that may cause interference to the victim receiver (proposed or existing) as identified in step 1 (unwanted path). In the stage 1 coordination procedure, the free

space propagation model is used as defined in ITU-R Recommendation P.525 [11].

Note: In the case of assessing interference into Earth Station receivers, assigners must use the propagation model defined in ITU-R Recommendation P.452 [12].

Step 5: Calculate free space propagation loss for wanted paths

Step 5 of the coordination procedure, which is only relevant for interference into point-to-point links, is to calculate the propagation loss between each receiver of the wanted transmit to receive pair (wanted path). In the stage 1 coordination procedure, the free space propagation model is used.

Step 6: Determine wanted signal power at each receiver from its associated transmitter

Step 6 of the coordination procedure is to calculate the level of wanted power at each receiver identified in step 1, using the wanted path propagation loss from step 5. This step is only relevant in the case of interference into point-to-point link receivers.

The data required for these calculations include the system transmitter power, the system transmit antenna gain and the propagation loss of the wanted path calculated in step 5. (In the case of interference into point-to-point links, the power levels for both the wanted and unwanted signals are calculated at the input to the victim receiver antenna, and therefore the receiver antenna gain is not required; only the antenna discrimination needs to be taken into account).

Step 7: Determine the unwanted power at each receiver from each potential interfering transmitter

Step 7 of the coordination procedure is to calculate the level of unwanted power at each receiver identified in step 1, using the unwanted path propagation loss from step 4.

The data required for these calculations includes the transmitter EIRP in the direction of the victim receiver, the victim receiver antenna gain, the discrimination of the victim receive antenna in the direction of the unwanted system and the propagation loss.

Step 8: Determine the required protection criteria for each identified victim receiver

Step 8 of the coordination procedure is to determine the applicable protection criteria for each victim receiver identified in step 1. To protect receivers from unacceptable interference, the wanted and/or unwanted power levels at a victim receiver must not exceed the required protection criteria for that receiver.

In this RALI protection ratios are used for protection of fixed link receivers while a maximum allowable unwanted level criterion is used for protection of BWA, and other services receivers.

When applying protection ratios for the protection of fixed link receivers, the protection ratios should be adjusted to take account of actual path length and geoclimatic zone. Protection ratio correction factor graphs are provided at Attachment 2c.

For the point-to-area BWA service, the receiver protection criterion used must reflect the channel bandwidth of the system. BWA service protection criteria is provided in Attachment 2a & 3.

For FSS Earth Station receivers, coordination is carried out on a 'per MHz' basis, see Attachment 5 for further details.

Example of Protection Ratio correction factor adjustment

An example calculation of the protection ratio for a digital fixed link receiver with the following parameters is shown below:

$$PR = PR_{co} + CF$$

where

PR – protection ratio

PR_{co} – co channel protection ratio

CF - Correction Factor ¹⁰

Input data:

Centre Frequency	=	1.9 GHz
bandwidth	=	14 MHz
P _L	=	10
link path length	=	50 km

Result:

$$PR_{co} = 60 \text{ dB}$$

$$CF = -7 \text{ (adjustment for } d = 50 \text{ km and } PL=10)$$

$$PR = 60 + (-7) = 53 \text{ dB}$$

Step 9: Comparison with protection criteria.

Step 9 of the coordination procedure compares the calculated levels from Step 6 and Step 7 with the protection values obtained from Step 8. Two cases are detailed below depending on which type of protection criteria is required.

Case one: Protection Ratio

The protection criterion is met for a particular victim receiver if the wanted-to-unwanted power ratio equals or exceeds the required protection ratio for that receiver. That is:

$$\text{Wanted Signal} - \text{Unwanted Signal} - \text{Protection ratio} \geq 0$$

If the wanted-to-unwanted power ratio equals or exceeds the protection ratio for each victim receiver then the protection criteria has been met and spectrum sharing is possible. However, if the wanted-to-unwanted power ratio is less than the protection ratio at any of the victim receivers then, for those receivers, further coordination assessments using a more refined propagation model can be undertaken (refer to stage 2, following).

Case two: Maximum Unwanted Level

The unwanted signal level at the victim receiver is compared to a maximum allowed unwanted level. This is generally expressed in dBm per bandwidth (eg. dBm/5MHz). It is important to note that the levels being compared must be measured in the same reference bandwidth (i.e. it is not correct to compare dBm/5MHz with dBm/10MHz).

If the unwanted signal level exceeds the maximum unwanted level for each victim

¹⁰ see Attachment 2c

receiver then the transmitter is deemed to be causing unacceptable interference. However, if the unwanted signal level is equal to or less than the maximum unwanted level for each victim receiver then the protection criteria has been met and spectrum sharing is possible.

Note: Where Protection ratios and Protection Criteria are required for frequency offset values other than those shown in the tables in Attachment 2 the value applying to the lesser offset case should be used.

Stage 2

For protection criteria comparisons that fail the initial (stage 1) coordination assessment, further assessment (stage 2) of the interference potential is required.

In stage 1, the free space propagation model does not take into account obstructions due to terrain, buildings or vegetation. These factors can significantly increase the loss on each interference path (but particularly for long unwanted paths). Consideration of this and other factors in stage 2 is likely to reduce the calculated interference levels and may lead to a successful coordination of the system.

The decision on the propagation model to be applied for a particular path in stage 2 is to be determined by the frequency assigner, taking all relevant factors into account. Note: In the case of assessing interference into Earth Station receivers, assigners must use the propagation model defined in ITU-R Recommendation P.452.

Step 10: Re-calculate propagation losses using alternative propagation model(s)

For the victim receivers that fail the Stage 1 coordination assessment, propagation losses between the proposed system and the victim receivers can be re-calculated, using relevant alternative propagation models.

It should be noted however, that the free space propagation model may, in many cases, be the most appropriate model. However, due to the wide variability in antenna heights, no single model can be recommended as being the most appropriate for all paths. In determining which propagation model is most appropriate for a particular path, consideration should be given to factors such as:

- the terrain between the radio path end points;
- any obstructions on the path either natural or man-made;
- the heights of the transmit and receive antennas; and,
- the limitations of applicability of the various propagation models.

Determination of an appropriate propagation model for a particular path may be aided by plotting a terrain profile for the path. The following discussion may assist frequency assigners in considering suitable propagation models for use in stage 2.

Propagation Models

Path losses between systems may arise through a range of propagation mechanisms, depending on the factors described above. Some of the main propagation mechanisms are: line of sight (free space loss as used in stage 1), and diffraction including smooth earth diffraction and diffraction over obstacles and irregular terrain (knife-edge diffraction), ducting and tropospheric scatter.

Information on how to determine propagation losses due to diffraction over obstacles and irregular terrain can be found in ITU-R Recommendation P 526, which also covers spherical Earth diffraction.

The interference protection criteria specified in the RALI FX-3 are applicable for interference levels exceeded for 20% of the time. Therefore, when drawing a path profile to calculate diffraction losses an Earth curvature factor of $k = 3$ should be used. This will give results corresponding to signal levels exceeded for 20% of the time. There is no need to apply a correction factor for location variability as the method yields results only appropriate to the one receiver location.

Information on how to determine propagation losses due to diffraction over obstacles and irregular terrain, spherical Earth diffraction, tropospheric scatter as well as ducting can also be found in ITU-R Recommendation P 452.

Step 11: Re-calculate unwanted power and compare against protection ratio

The level of unwanted power at each fixed link receiver that could not be co-ordinated at Stage 1 should be re-calculated as described in step 7, using the revised propagation loss value.

The revised wanted-to-unwanted power ratio should be compared against the protection ratio as described in Step 9. If the wanted-to-unwanted power ratio at each of the remaining victim receivers equals or exceeds the required protection ratio for each receiver then the protection criteria is met and spectrum sharing is possible.

4.3 Further Options if Coordination is not successful

If the wanted-to-unwanted power ratio is less than the required protection ratio at a fixed link receiver, or the protected receiver input level at a victim receiver (BWA or other systems) is not met, then spectrum sharing is not possible unless further steps are taken by the applicant. If the proposal is to be pursued further, the applicant may consider the following options:

- modifying the configuration of the proposed system to meet the protection criteria (this may include modifying the equipment to limit operation to a smaller portion of the band, or changing the locations, antenna height, proposed EIRP, etc.);
- negotiating an agreement with the affected or affecting service(s) regarding changes to the service(s) and/or the BWA system¹¹;
- applying for a licence to conduct test transmissions to assess the actual propagation loss.

4.4 Assessing Interference: BWA into Fixed Links

Interference from a BWA system into a fixed point-to-point receiver is assessed using

¹¹ Note: In cases involving predicted interference to or from point-to-point fixed links in the 1900-1920 MHz band, the 1900-1920 MHz Frequency Band Plan 2012 sets a status priority between BWA and point-to-point fixed services that can be used to settle disputes. In cases involving predicted interference to or from Amateur Repeaters in the 3575-3600 MHz band, the Australian Radiofrequency Spectrum Plan (ARSP) sets a status priority between BWA and Amateur services that can be used to settle disputes. However, it is desirable that both parties negotiate on these issues and only use the Band Plan or ARSP as a last resort. In many cases this could allow the introduction of the BWA service while allowing continued operation of the point-to-point fixed links or amateur services. However, in the event that an agreement to deal with the predicted interference cannot be achieved, under the terms of the 1900-1920 MHz Frequency Band Plan 2012, the potentially affected/affecting point-to-point fixed service licensee will need to vacate the frequency after 17 December 2005. This similarly applies in the 3575-3600 MHz band, where the ARSP defines Amateur services as secondary in the band.

the Steps described in section 4.2. Steps 1 to 9, and then Step 10 and 11 (if required) in conjunction with the additional clarifications given below are to be followed.

Two scenarios are considered together in this section:

- interference from a proposed BWA transmitter to a licensed Fixed Link receiver
- interference from a licensed BWA transmitter to a proposed Fixed Link receiver

The coordination process calculates a wanted-to-unwanted signal level ratio at the fixed link receiver input and compares it against the relevant protection ratio value(s) given in the tables in Attachment 2b.

Figure 6 illustrates the wanted and unwanted paths on the basis of the BWA deployment model detailed in Attachment 3.

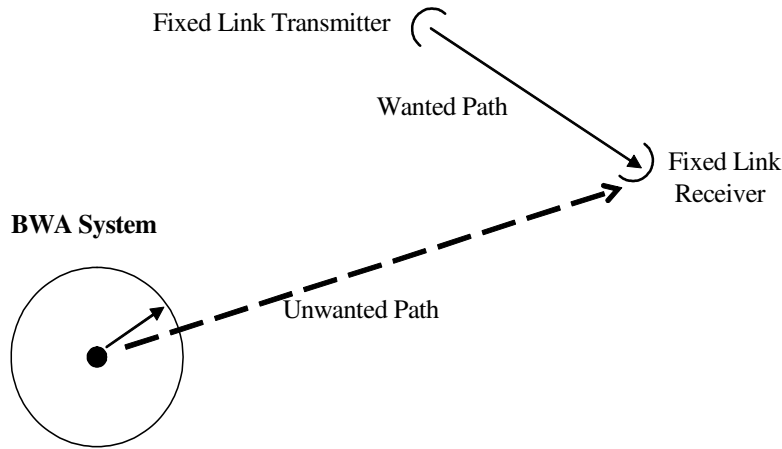


Figure 6. Interference scenario BWA into Fixed Link

Specific Step Clarification

Step 1: To identify the potentially affected fixed link receivers, a recommended minimum distance cull around the site of the proposed BWA base station of 200 km is required. Anything within this radius should be included in the following steps.

A frequency cull is then applied to further reduce the number of cases requiring more detailed coordination calculations. Noting that different situations apply with respect to sharing with other services in the two bands, the required frequency culls are:

BWA Band	Fixed Link Receiver Frequency Cull Range
1900 – 1920 MHz	1867.5 – 1980 MHz
3575 – 3700 MHz	3590 – 3770 MHz

If a BWA base station occupies spectrum at or within the second adjacent channel of the fixed link receiver channel and the geographical location of the BWA base station is

within 10 km¹² of the fixed link receiver, coordination is deemed to fail and a licence will not be granted.

Step 3:

For BWA Transmitter: Calculation of the BWA transmitter antenna gain detailed in Step 3 is done on the basis of the licensed or proposed antenna data.

Note: The BWA transmitter gain value can be reduced by the amount of antenna discrimination (if any) at the given azimuth by using the actual RPE and polarisation discrimination if applicable. If the RPE is not available then the worst-case (maximum gain) value is to be used.

For Fixed Receiver: The actual antenna discrimination of the fixed link receive antenna should be used for the calculations.

Step 7: This step requires two parallel calculations to be made and the more conservative (i.e. higher EIRP) resulting value to be used in subsequent stages of the calculation procedure. The two cases are:

Case 1 Calculate the unwanted power level (EIRP) on the basis of the proposed or licensed details for the base transmitter using the above calculated antenna gain (with any discrimination taken into account) and the proposed or licensed transmitter power, taking into account the path loss calculated in Step 4.

Case 2 Calculate the unwanted power level (EIRP) on the basis of the remote station notional details, this requires using a 14 dBi omni-directional antenna, located at the base station transmitter site, placed at the same height as the base station antenna and taking into account the path loss calculated in Step 4.

Step 9: A comparison of the calculated wanted-to-unwanted ratio from Steps 6 and 7 with the relevant protection ratio value(s) in the tables in Attachment 2B will determine if the protection criteria at the victim fixed link receiver is achieved.

4.5 Assessing Interference: Fixed Links into BWA

Interference from a point-to-point fixed link transmitter into a BWA system receiver is assessed using the Steps described in section 4.2. Steps 1 to 9, and then step 10 and 11 (if required) in conjunction with the additional clarifications given below are to be followed.

Two scenarios are considered together in this section:

- interference from a proposed Fixed Link to a licensed BWA receiver
- interference from a licensed Fixed Link to a proposed BWA receiver

The coordination process is to calculate the unwanted signal level at the potential BWA

¹² Prospective licensees are reminded that remote stations operate on a 'no interference' basis as defined in the Radiocommunications Licence Conditions (Fixed Licence) Determination. The 10 km minimum separation distance requirement stated here is intended to reduce the potential for BWA remote stations to cause harmful interference into a fixed link receiver while also ensuring that BWA licensees have a reasonable chance to service the area surrounding the proposed BWA base station without causing interference to fixed link receivers.

victim receiver and compare it against relevant protection criteria given in the tables in Attachment 2a.

Figure 7 illustrates the wanted and unwanted paths on the basis of the BWA deployment model detailed in Attachment 3.

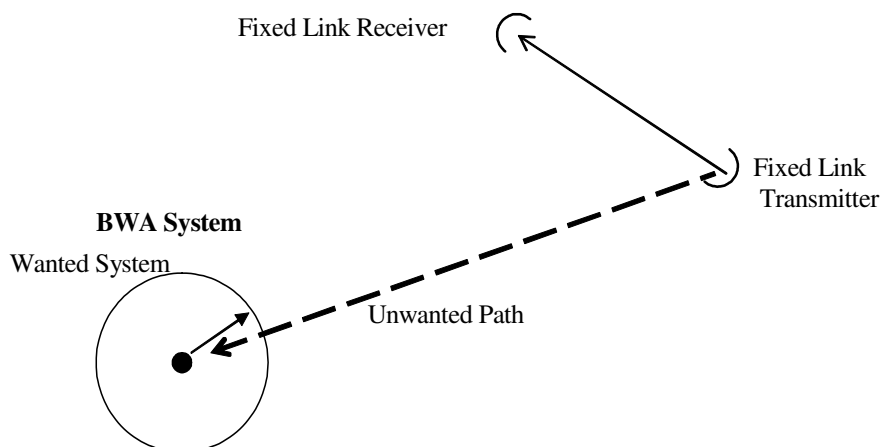


Figure 7. Interference scenario Fixed Link into BWA

Specific Step Clarification

Step 1: To identify potentially interfering fixed link transmitters, a recommended minimum distance cull around the site of the proposed BWA station of 200 km is required. Anything within this radius should be included in the following steps.

A frequency cull is then applied to further reduce the number of cases requiring more detailed coordination calculations. Noting that different situations apply with respect to sharing with other services in the two bands, the required frequency culls are:

BWA Band	Fixed Link Transmitter Frequency Cull Range
1900 - 1920 MHz	1874.5 – 1951 MHz
3575 – 3700 MHz	3590-3730 MHz

Step 3:

For BWA Receiver: Calculation of the BWA receiver antenna gain detailed in Step 3 is done on the basis of the licensed or proposed base station antenna data.

Note: The BWA receiver gain value can be reduced by the amount of antenna discrimination (if any) at the given azimuth by using the actual RPE where available. If the RPE is not available then the worst-case (maximum gain) value is to be used. Polarisation discrimination, if applicable, may also be taken into account.

For Fixed Transmitter: The actual antenna discrimination of the fixed link transmitter should be used for the calculations.

Step 9: A comparison of the relevant values in Attachment 2a, and the calculated unwanted signal levels (e.g. dBm/5 MHz) from Step 7 will determine if the level of interference into the BWA receiver is acceptable. It is important to note that the levels being compared are measured in the same reference bandwidth.

4.6 Assessing Interference: Amateur Services into BWA

Interference from an amateur service transmitter into a BWA system receiver is assessed using the Steps described in section 4.2. Steps 1 to 9 and then Step 10 and 11 (if required), in conjunction with the additional clarifications given below, are to be followed.

The coordination process is to calculate the unwanted signal level at the potential BWA victim receiver and compare it against relevant protection criteria given in the tables in Attachment 2a.

Specific Step Clarification

Step 1: To identify potentially interfering Amateur service transmitters, a recommended minimum distance cull around the site of the proposed BWA station of 200 km is required. Anything within this radius should be included in the following steps.

A frequency cull is then applied to further reduce the number of cases requiring more detailed coordination calculations. The required frequency cull is:

BWA Service	Amateur Service Band Frequency Cull Range
3575-3630 MHz	3575 – 3600 MHz

Step 3:

For BWA Receiver: Calculation of the BWA receiver antenna gain detailed in Step 3 is done on the basis of the licensed or proposed base station antenna data.

Note: The BWA receiver gain value can be reduced by the amount of antenna discrimination (if any) at the given azimuth by using the actual RPE where available. If the RPE is not available then the worst-case (maximum gain) value is to be used. Polarisation discrimination, if applicable, may also be taken into account.

For Amateur Transmitter: The actual antenna discrimination of the amateur service transmitter should be used for the calculations.

Note: The amateur transmitter gain value can be reduced by the amount of antenna discrimination (if any) at the given azimuth by using the actual RPE and polarisation discrimination if applicable. If the RPE is not available then the worst-case (maximum gain and Omni directional antenna) value is to be used.

Step 9: A comparison of the relevant values in Attachment 2a, and the calculated unwanted signal levels (e.g. dBm/10 MHz) from Step 7 will determine if the level of interference into the BWA receiver is acceptable. It is important to note that the levels being compared are measured in the same reference bandwidth.

4.7 Assessing Interference: BWA to BWA

Note: This process is not required between stations operated by the same licensee, as it is expected that the licensees will manage interference between their own stations

Interference from a BWA system transmitter into each potential victim BWA system receiver is assessed using the Steps described in section 4.2. Steps 1 to 9, and then steps 10 and 11 (if required) in conjunction with the additional clarifications given below are to be followed.

Two scenarios are considered together in this section:

- interference from a proposed BWA transmitter to a licensed BWA receiver; and
- interference from a licensed BWA transmitter to a proposed BWA receiver.

The coordination process is to calculate the unwanted signal level at the potential BWA victim receiver and compare it against relevant protection criteria given in the tables in Attachment 2a.

Figure 8 illustrates the wanted and unwanted paths on the basis of the deployment model detailed in Attachment 3.

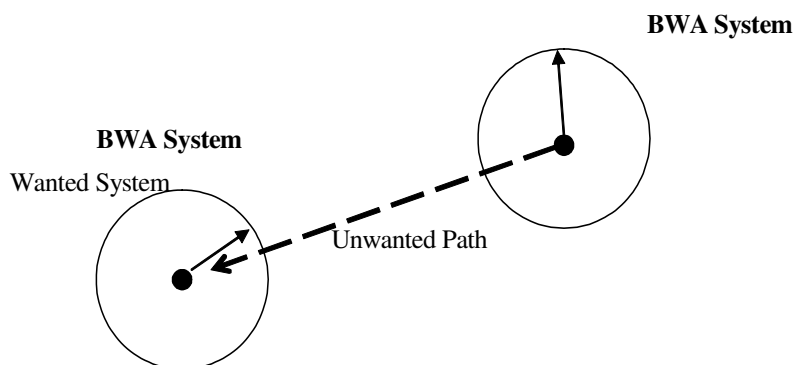


Figure 8. Interference scenario BWA into BWA

Specific Step Clarification

Step 1: To identify the potentially affected BWA receivers, a recommended minimum distance cull around the BWA transmitter site of 200 km is required. Anything within this radius should be included in the following steps. A minimum co-channel reuse distance of 30 km will be applied to BWA base stations operated by different licensees. Within this distance of an existing BWA base station location, other co-channel BWA applications will not be considered. Beyond this reuse distance of 30 km, the co-channel co-ordination procedure detailed in the following steps should be followed.

A frequency cull is also applied to further reduce the number of cases requiring more detailed coordination calculations. Given the range of current and future operating bandwidths feasible, a generic frequency cull range of 1.5 times the channel bandwidth can be applied. This results in the following band specific cull ranges:

- 1900-1920 MHz band: in this case, the wanted and unwanted systems are assumed to have the same 5 MHz bandwidth, so the frequency culls are made at ± 7.5 MHz from the centre frequency of the proposed channel;
- 3575-3700 MHz band: in this case the channel bandwidth for the wanted and unwanted systems is assumed to be ≤ 30 MHz. This corresponds to a maximum frequency cull range of ± 45 MHz from the centre frequency of the proposed channel to ensure no overlapping channels. This can be reduced on a case by case basis depending on the actual channel bandwidth.

Step 3:

For BWA Transmitter: Calculation of the BWA transmitter antenna gain detailed in Step 3 is done on the basis of the licensed or proposed antenna data.

Note: The BWA transmitter gain value can be reduced by the amount of antenna discrimination (if any) at the given azimuth by using the actual RPE where available. If the RPE is not available then the worst-case (maximum gain) value is to be used.

For BWA Receiver: Calculation of the BWA receiver antenna gain detailed in Step 3 is done on the basis of the licensed or proposed base station antenna data.

Note: The BWA receiver gain value can be reduced by the amount of antenna discrimination (if any) at the given azimuth by using the actual RPE where available. If the RPE is not available then the worst-case (maximum gain) value is to be used. Polarisation discrimination, if applicable, may also be taken into account.

Step 7: Calculate the unwanted power level on the basis of the proposed or licensed details for the base transmitter using the above calculated antenna gain (with any discrimination taken into account) and the proposed or licensed transmitter power, taking into account the path loss calculated in Step 4.

Step 9: A comparison of the relevant values in Attachment 2a, and the calculated unwanted signal levels (e.g. dBm/5 MHz) from Step 7 will determine if the level of interference into the BWA receiver is acceptable. It is important to note that the levels being compared are measured in the same reference bandwidth.

4.8 Assessing interference: BWA to Spectrum Licensed Rx

New BWA systems can only be deployed outside those areas allocated for spectrum licensing. Interference from new BWA systems into an area allocated for spectrum licensing is managed by following the procedure at attachment 4. This procedure is considered sufficient to also protect devices operating under a spectrum licence from adjacent channel interference.

Interference from an adjacent band BWA system into a spectrum licensed victim receiver operating in the 3542.5-3700 MHz band can only occur from existing BWA services. As such, it is left to spectrum licensee's to assess the risk of interference to any proposed spectrum licence receivers and mitigate any potential interference concerns.

4.9 Assessing interference: Spectrum Licensed Tx to BWA

As with section 4.8, new BWA systems can only be deployed outside those areas allocated for spectrum licensing. Interference to new BWA systems into an area allocated for spectrum licensing is managed by following the procedure at Attachment 4. This procedure is considered sufficient to also protect new BWA systems from adjacent channel interference.

Interference to any incumbent BWA systems operating in areas allocated for spectrum licensing still needs to be assessed. Interference from a spectrum licensed transmitter operating in the 3542.5-3700 MHz band into a BWA base station receiver operating in the frequency range 3575 – 3700 MHz is assessed using the steps described in section 4.2. Steps 1 to 9 and then steps 10 and 11 (if required) in conjunction with the additional clarifications given below are to be followed.

Any proposed spectrum licence transmitters are required to coordinate with any BWA receivers that fall within a 95 km radius and within the frequency range 3542.5-3700 MHz.

The coordination process is to calculate the unwanted signal level at the potential victim receiver and compare it against a minimum level of protection. The protection criteria for BWA receivers is given in Attachment 2a. The interference criterion was developed by determining the amount of unwanted emissions from the proposed or existing transmitter falling within the victim's receiver selectivity response.

Figure 9 illustrates the unwanted path on the basis of the BWA deployment model detailed in Attachment 3.

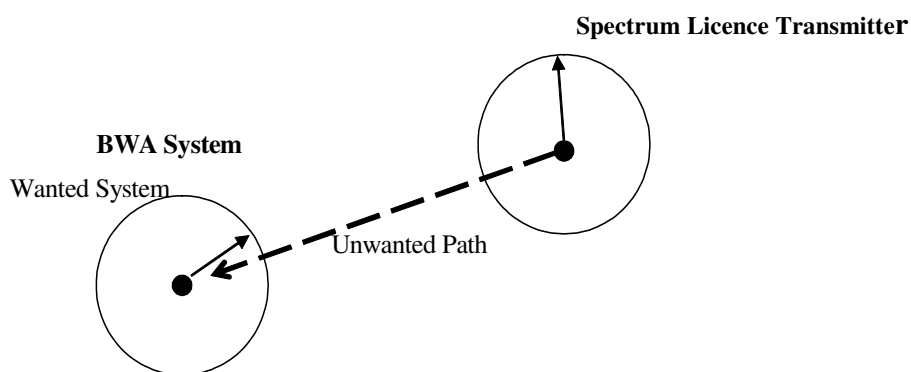


Figure 9. Interference scenario Spectrum Licensed Transmitter to BWA receiver

Specific Step Clarification

Notes:

- For co-channel operation, a minimum separation distance of 20 km applies.
- For adjacent channel operation with a guard band of less than 10 MHz, a minimum separation distance of 5 km applies.
- For adjacent channel operation with a guard band of 10 MHz or greater, there is no minimum separation distance required, however coordination calculations must consider the impact of transmitter noise and receiver blocking on the victims receiver/s.
- There is no requirement for detailed coordination if the proposed spectrum licensed transmitter and the victim BWA receiver are synchronised such that their transmit/receive cycles are aligned.

Note: The licensee who is second-in-time is responsible for bearing the costs of any changes required to facilitate coexistence.

Step 9: A comparison of the relevant values in Attachment 2a and the calculated unwanted signal levels from Step 7 will determine if the level of interference into the BWA receiver is acceptable. It is important to note that the levels being compared are measured in the same reference bandwidth.

4.10 Assessing interference: BWA to FSS (3700-4200 MHz)

Interference from a BWA transmitter into an Earth Station receiver is assessed using the steps described in section 4.2. Steps 1 to 9, and then steps 10 and 11 (if required) in

conjunction with the additional clarifications given below are to be followed.

The coordination process is to calculate the unwanted signal level at the potential victim receiver and compare it against a minimum level of protection. The protection criteria for Earth Station receivers is given in Attachment 2d and further explanation is provided in Attachment 5.

Specific Step Clarification

Step 1: To identify potentially affected Earth station receivers, a recommended minimum distance cull around the site of the proposed BWA station of 100 km is required. Any licensed Earth station within this radius should be included in the following steps.

Note that:

- a minimum 20km separation distance applies between a BWA station and an Earth station;
- coordination can be simplified for situations involving a BWA station and an Earth Station with a guard band of greater than or equal to 10 MHz (where guard band is defined in Attachment 2d). In this scenario a minimum 20 km separation is required to satisfy coordination.

Step 3:

Transmitter details: Calculation of the transmitter antenna gain detailed in Step 3 is done using the maximum EIRP stated on the licence application and an omni directional antenna.

Note: In this scenario the worst-case (maximum gain) value is to be used in order to account for scenarios where the remote station may be the worst case interferer. Polarisation discrimination, if applicable, may also be taken into account. See attachment 5 for further details.

Receiver details: Calculation of the receiver antenna gain detailed in Step 3 is done on the basis of the licensed station antenna gain.

Note: The receiver gain value can be reduced by the amount of antenna discrimination (if any) at the given azimuth by using the actual RPE where available. If the RPE is not available then the antenna pattern described in ITU-R Recommendation S.465-5 is to be used.

Step 9: A comparison of the relevant values in Attachment 2d, and the calculated unwanted signal levels from Step 7 will determine if the level of interference into the Earth Station receiver is acceptable. It is important to note that the levels being compared are measured in the same reference bandwidth.

Step 10: If re-calculation using a model other than free space loss is required, it is noted that the propagation model defined in ITU-R Recommendation P.452 for long term time criteria (20% time), worst month, and clear sky conditions should be used.

4.11 Assessing interference: BWA to FSS (3600-3700 MHz)

Interference from a BWA transmitter into an Earth station receiver is assessed using the steps described in section 4.2 in conjunction with the additional clarifications given below.

The coordination process is to calculate the unwanted signal level at the potential victim receiver and compare it against a minimum level of protection. The protection criteria for Earth station receivers is given in Attachment 2d and further clarification is given in Attachment 5.

Specific Step Clarification

Step 1: To identify potentially affected Earth station receivers, a recommended distance cull around the site of the proposed BWA station as described below is required. Any licensed Earth station, operating on the specified frequencies within this radius should be included in the following steps.

Operating Frequency (for BWA services)	Cull Distance around Earth Station receivers
3600 - 3670 MHz	200 km
3670 – 3700 MHz	150 km

Step 3:

Transmitter details: Calculation of the transmitter antenna gain detailed in Step 3 is done on the basis of the proposed station antenna data.

Note: The transmitter gain value can be reduced by the amount of antenna discrimination (if any) at the given azimuth by using the actual RPE where available. If the RPE is not available then the worst-case (maximum gain) value is to be used. Polarisation discrimination, for cases involving main beam coupling, may also be taken into account.

Receiver details: Calculation of the receiver antenna gain detailed in Step 3 is done on the basis of the licensed station antenna gain.

Note: The receiver gain value can be reduced by the amount of antenna discrimination (if any) at the given azimuth by using the actual RPE where available. If the RPE is not available then the antenna pattern described in ITU-R Recommendation S.465-5 is to be used.

Step 4: Step 4 of the coordination procedure is to calculate the propagation loss between the proposed BWA transmitter and the victim Earth station receiver as identified in step 1 (unwanted path). Frequency assigners should note that in the case of co-channel coordination with Earth stations operating in the 3600-3700 MHz band, coordination is to be conducted for both long and short term time percentages (20% and 0.0017% respectively), using the propagation model defined in ITU-R Recommendation P.452 using worst month parameters under clear sky conditions and the ‘per MHz’ approach described in Attachment 5.

Step 7: Calculate the unwanted power level on the basis of the actual details for the proposed transmitter and the victim receiver using the above calculated antenna gains (with any discrimination taken into account), taking into account the path loss calculated in step 4.

Step 9: A comparison of the relevant values in Attachment 2d, and the calculated unwanted signal levels from Step 7 will determine if the level of interference into the Earth Station receiver is acceptable. It is important to note that the levels being

compared are measured in the same reference bandwidth.

4.12 Site Engineering Aspects

At shared sites, or sites in close proximity, a number of potential interference mechanisms other than co-channel or adjacent channel interference may occur. These include: intermodulation; transient and spurious emissions; receiver desensitisation; and, physical blocking. These mechanisms are caused by non-linear and often complex processes that are, usually, not readily predicted using information contained in the ACMA's RRL. Nevertheless, a number of "site engineering" methods can be applied to address these potential interference scenarios. These include, but are not limited to, site shielding, frequency separation, site locations, equipment synchronisation and power reduction.

Most of the above mentioned methods require co-operation and co-ordination between licensees. This is most easily achieved where the two systems are owned by the same licensee. In reality however, neighbouring systems are seldom owned by the same licensee, and therefore formal discussions may be required.

In the case of co-siting with spectrum licensed devices, if the interference from the spectrum licensed device is not the result of operation of a radiocommunications device in a manner that does not comply with the respective conditions of the licence, then licensees must take reasonable steps to negotiate arrangements likely to reduce the interference to acceptable levels. To assist in such situations, operators are also referred to the *3.4 GHz Spectrum Licence Technical Framework – Guidelines [8]* which specify a minimum spectrum licence notional receiver performance.

The ACMA expects that licensees (or their site managers) will work cooperatively and apply good site engineering practice to resolve problems¹³.

4.13 Assignment Rules

4.13.1 1900-1920 MHz band

Where an applicant already has assigned 1900-1920 MHz band channels, that applicant should wherever possible be assigned the same channels. (This measure is intended to promote efficient spectrum use by requiring self-management of co-channel, adjacent area interference to the greatest extent practical).

In addition to this, assignments in the 1900-1920 MHz band should be made with respect to the intended spectrum use. For example although up to 20 MHz of spectrum is available at a single site, if the intention is to use two separate 10 MHz channels then the use should be recorded as such (whether for a directional or omni-directional system) rather than as one 20 MHz channel.

This requirement ensures coordination with other services such as PTS and point-to-point links is based as closely as possible on actual system characteristics. This will best ensure spectrum availability to all services operating in and around 1.9 GHz band.

Rules relating to applications for two or more 5 MHz channels¹⁴

Applicants seeking two or more 5 MHz channels in the same area should, where

¹³ Refer to RALI FX-3 section 3.3 for further discussion.

¹⁴ In the event that an applicant with an initial assignment applies for a further assignment(s) in the same area, the rules relating to applications for two or more 5 MHz channels shall apply to each subsequent application.

possible, be assigned contiguous lots. Licensees in this situation will be expected to manage their frequency reuse arrangements within this constraint.

Where applicants seek two 5 MHz channels, assessments should be performed firstly on the 1910-1920 MHz pair and then the 1900-1910 MHz pair. (This rule is intended to maximise separation from 1880-1900 MHz band DECT services).

Rules relating to applications for one 5 MHz channel

Where applicants seek a single 5 MHz channel assessments should be made in the following order:

- 1915-1920 MHz;
- 1900-1905 MHz;
- 1910-1915 MHz;
- 1905-1910 MHz.

This rule is intended firstly to maximise separation from other BWA services, current or potential future and, as a second priority, to maximise separation from 1880-1900 MHz band DECT services.

Rules relating to applications for one 10 MHz channel

Where applicants seek a single 10 MHz channel, assessments should be made in the following order:

- 1910-1920 MHz;
- 1900-1910 MHz;
- 1905-1915 MHz;

This rule is intended to, as far as possible, ensure any remaining spectrum is in a contiguous 10 MHz lot. As a second priority, it is intended to maximise separation from 1880-1900 MHz band DECT services.

4.13.2 3575-3700 MHz band

Where an applicant already has assigned 3575-3700 MHz band channel(s):

- in an adjacent area, for example outside a township or regional population centre¹⁵, that applicant should wherever possible be assigned the same channels;
- at the same site or in the same area, that applicant should wherever possible be assigned contiguous spectrum lots .

These measures are intended to promote efficient use of spectrum by requiring applicants to self-manage co-channel and adjacent channel interference to the greatest extent practical.

In the 3575-3700 MHz band, channels should be assigned from the lowest channel upward to maximise separation from the 3700-4200 MHz Fixed Satellite Service band.

Furthermore, assignments with an EIRP density of 30 dBm/MHz or lower should be assigned in the 3680-3700 MHz band, where possible. This is aimed at maximising the

¹⁵ Additional criteria relating to spectrum limitations, as defined in section 1.2 of this RALI also apply.

availability of spectrum to higher power services.

Until a review of point-to-point use of the 3575-3700 MHz band is complete, the channel plan in Figure 1 shall be in force. Channels are aligned with the fixed link channel arrangements as described in RALI FX3 in order to maximise use of available spectrum in areas where point-to-point links are currently deployed.

4.13.4 Summary table: assignment priority rules

1900-1920 MHz	3575-3700 MHz
<p>1. If the licensee has BWA channel(s) in an adjacent area, assign the same channel(s) where possible.</p> <p>2a. Where applicants apply for two 5 MHz channels in the 1900-1920 MHz range the assessment priority order is:</p> <ol style="list-style-type: none"> 1. 1910-1920 MHz 2. 1900-1910 MHz <p>2b. Where applicants apply for one channel in the 1900-1920 MHz range the assessment priority order is:</p> <ol style="list-style-type: none"> 1. 1915-1920 MHz 2. 1900-1905 MHz 3. 1910-1915 MHz 4. 1905-1910 MHz <p>3. Where an applicant applies for a single 10 MHz channel, the assignment priority is:</p> <ol style="list-style-type: none"> 1. 1910-1920 MHz 2. 1900-1910 MHz 3. 1905-1915 MHz 	<p>1. If the licensee has BWA channel(s) in an adjacent area, assign the same channel(s) where possible.</p> <p>2. If a licensee has BWA channel(s) in a specific area or site, assign contiguous channel(s) where possible.</p> <p>3. Assign lowest available contiguous channels first. Then assign lowest available channels.</p> <p>4. Assignments with an EIRP density of 30 dBm/MHz or lower should be assigned in the 3680-3700 MHz band, where possible.</p>

Table 3: Channel assignment priority instructions

Part 5: Licensing

5.1 Overview of Licensing

All transmitters in a particular BWA system (comprising only one base station and a number of remote stations communicating with that base station) are to be licensed under one Fixed licence authorising a Point-to-Multipoint station.

A Point to Multipoint station is defined in the *Radiocommunications (Interpretation) Determination 2015 [15]* as:

...a station that:

- (a) is operated under a fixed licence; and
- (b) is operated principally for communication with more than 1 other fixed station; and
- (c) is operated on frequencies specified in the transmitter licence that relates to the station.

To be licensed for operation BWA point-to-multipoint fixed systems must be located outside areas defined in either the *Radiocommunications (Spectrum Re-allocation Declaration) [5]* (for the 1900-1920 MHz band), or relevant spectrum embargoes defined in the ACMA's *RALI MS03: Spectrum Embargoes [6]* (for the 1900-1920 MHz and 3575-3700 MHz bands).

In the 3575-3700 MHz band, 10 MHz and 20 MHz channelling applies, as depicted in Figure 1 of section 1.5. Please note the 15 MHz and 30 MHz arrangements no longer apply for new licences. They are included as there are numerous existing services using these channels that may need to be coordinated against.

In the 1900-1920 MHz band 5 MHz wide channelling will apply.

5.2 Licence Conditions

The operation of radiocommunications equipment authorised by a Fixed Licence is subject to:

- conditions specified in the *Radiocommunications Act 1992* (the Act), including an obligation to comply with the Act;
- conditions specified in the *Radiocommunications Licence Conditions (Apparatus Licence) Determination [16]*, *Radiocommunications Licence Conditions (Fixed Licence) Determination [3]* and any other determinations made by the ACMA under section 107(1)(f) of the Act;
- conditions specified in this RALI;
- conditions specified in the licence; and
- any further conditions imposed by the ACMA under section 111 of the Act.

In the event that interference occurs after a licence is issued and the issue cannot be resolved between the affected parties, licensees can expect the ACMA to have regard to this RALI and relevant legislative instruments in dealing with the dispute. The ACMA will also pay particular attention to Annex 1 of Attachment 3 for licences issued in the 3575-3700 MHz band.

5.2.1 Special Conditions

Conditions of operation, which apply to an individual licence, will be printed on the licence under the heading ‘Special Conditions’.

The application of special conditions by the ACMA will be considered on a case by case basis as required.

In the 3.6 GHz band there are a number of potential channel bandwidths that may be deployed by licensees. Note that 15 MHz and 30 MHz channel bandwidths are no longer available for new licences. They are included as there are numerous existing services using these channels that may need to be coordinated against. Typical profile bandwidths supported by equipment include 5 MHz, 7 MHz, 10 MHz and 20 MHz. It is further expected that in many cases, in order to deploy a metro comparable service, channel sizes of > 7 MHz will be used.

To provide further options for operators wishing to deploy services using smaller channel bandwidths than specified on the channel plan, **Special Condition FW** will be applied to all licences in the 3.6 GHz band:

The licensee must not deploy directional antennas using smaller necessary bandwidths than recorded on the Register of Radiocommunications Licences (RRL), unless all of the following conditions are met:

1. *All devices are located at the site as specified on the RRL; and*
2. *The power spectral density, determined from the transmitter power, antenna gain and necessary bandwidth details recorded on the RRL, is not to be exceeded at any time in any direction; and*
3. *The necessary bandwidth of any emissions are contained within the upper and lower frequency limits assigned to the licensee;*
4. *The antenna specified on the RRL is used; and*
5. *The antenna parameters are as recorded on the RRL, including polarisation, height and tilt.*

Further notes on the use of **Special Condition FW**:

- Frequency Coordination is performed using the antenna details and transmission power provided and assuming the entire channel bandwidth is used (i.e. 10, 15, 20 or 30 MHz as appropriate).
- In regards to condition 2 of **Special Condition FW**, if the EIRP and necessary bandwidth stated on the licence are 50 dBm and 15 MHz respectively, the power spectral density must not exceed 38.2 dBm EIRP/MHz [$50 - 10\log(15)$].

5.2.2 Advisory Notes

The following user selectable **advisory note FR** must be attached to all licences authorising BWA systems in the 1900-1920 MHz band:

‘The shared spectrum arrangements and uncoordinated nature of class licensed radiocommunications devices in the 1880-1900 MHz band:

- a. *may result in interference from nearby class licensed radiocommunications devices that may reduce system performance; and*

- b. *the likelihood of such interference is very low due to the dynamic channel allocation techniques inherent in cordless technologies used in the band;*
- and
- c. *protection from such interference cannot be afforded.*

The following user selectable **advisory note FA** must be attached to all licences for BWA sites operating in the 1900-1920 MHz band and located within 200 km of a spectrum licence boundary:

“If interference to a station operated under this licence is caused by a radiocommunications device that is authorised to operate under a spectrum licence, the ACA will consider any dispute from the starting point that the spectrum licence has priority over this licence, irrespective of the date that the spectrum licensed device was first operated.”

The following user selectable **advisory note FX** must be attached to all licences authorising BWA systems in the 3575-3700 MHz band:

Allocations exist in the Australian Radiofrequency Spectrum Plan 2009 for the Radiolocation service in the 3100-3300 MHz and the 3300-3600 MHz bands on a primary or co-primary basis under the AUS I and AUS11 footnotes respectively. The licensee is advised that the operation of Radiolocation devices by Defence in these bands may result in interference to BWA base stations and user terminals which may reduce system performance.

The following user selectable **advisory note FY** must be attached to all licences authorising BWA systems in the 3575-3700 MHz band inside and within 100 km of the Woomera Prohibited Area described in embargo 52

Defence may transmit on this frequency from time-to-time within the Woomera Prohibited Area. These activities may result in interference that may reduce system performance.

In regards to interference from Defence services, the ACMA will continue to consult on and monitor this issue with BWA licensees and Defence to best enable the coexistence of both services. The ACMA can also provide licensees inside and within 100 km of the WPA with a point of contact in Defence to talk to in regards to interference issues.

5.3 Spectrum Access Records

Technical details relating to the BWA system's base station, including, but not limited to, the actual operating transmit power, antenna, location, antenna height, antenna type and orientation and transmit/receive frequency band should be recorded.

Notes:

- Where sectored antennas are used, details of the antenna model, tilt, polarisation and azimuth¹⁶ should be recorded for each sector.
- Where steerable beam antennas are used details of the highest gain achievable through antenna phasing should be recorded.

¹⁶ Where the sectored antennas are combined to achieve an effectively omni-directional coverage (on a single channel) it is not necessary to specify the azimuth of each sector antenna.

- One of the coordination processes described in Part 4 requires that protection from remote stations be calculated on the basis of assumed notional “worst-case” parameters for the remote station located at the base station location. However, it is not required that data for this hypothecated remote station location should be recorded in the RRL.

5.4 3.6 GHz Band Specific Requirements

Licences in the 3.6 GHz band are also required to adhere to band specific conditions detailed in Annex 1 to Attachment 3 of this RALI. Some of these conditions include EIRP density limits, deployment constraints and relevant technical standards to be adhered to.

RALI Authorisation

Approved

08/July/2015

**Manager
Spectrum Engineering and Space Section
Spectrum Planning and Engineering Branch
Australian Communications and Media Authority**

Glossary

ACMA	Australian Communications and Media Authority
AL	Apparatus Licensed
BWA	Broadband Wireless Access
DECT	Digital Enhanced Cordless Telecommunications (previously known as Digital European Cordless Telecommunications)
EIRP	Equivalent Isotropically Radiated Power
FWA	Fixed Wireless Access
ITU	International Telecommunications Union
LCD	Licence Conditions Determination
MSS	Mobile Satellite Service
NFD	Net Filter Discrimination
PR	Protection Ratio
RALI	Radiocommunications Assignment and Licensing Instruction
RPE	Radiation Pattern Envelope
RRL	Register of Radiocommunication Licences
Rx	Receiver
SL	Spectrum licensed
TDD	Time Division Duplex
Tx	Transmitter
WAS	Wireless Access Service

REFERENCES

1. *1900-1920 MHz Frequency Band Plan 2012.*
<http://www.acma.gov.au/theACMA/19001920-frequency-band-plan-2012>
2. *Australian Radiofrequency Spectrum Plan 2013.*
<http://www.acma.gov.au/Industry/Spectrum/Spectrum-planning/About-spectrum-planning/australian-radiofrequency-spectrum-plan-spectrum-planning-acma>
3. *Radiocommunications Licence Conditions (Fixed Licence) Determination 2015.*
<https://www.legislation.gov.au/Details/F2015L01430>
4. RALI FX-3 Microwave Fixed Services - Frequency Co-ordination.
<http://www.acma.gov.au/theACMA/rali-fx3-microwave-fixed-services-frequency-coordination>
5. *Radiocommunications (Spectrum Re-allocation) Declaration No. 2 of 2000.*
6. RALI MS03: Spectrum Embargoes.
<http://www.acma.gov.au/Industry/Spectrum/Spectrum-planning/Current-APs-info-and-resources/spectrum-embargoes-spectrum-planning-acma>
7. *Radiocommunications Licence Conditions (Amateur Licence) Determination 2015.*
<https://www.legislation.gov.au/Details/F2015L01113>
8. 3.4 GHz Spectrum Licence Technical Framework – Advisory Guidelines
http://www.acma.gov.au/Industry/Spectrum/Spectrum-planning/About-spectrum-planning/technical-framework-3_4-ghz
9. RALI MS32 Coordination of Apparatus Licensed Services within The Australian Radio Quiet Zone Western Australia.
<https://www.acma.gov.au/-/media/Spectrum-Engineering/Information/Word-Document/RALI-MS32-ARQZWA.docx?la=en>
10. RALI MS33 Frequency Coordination and Licensing Procedures for Apparatus Licensed PTS in the 2 GHz Bands.
<https://www.acma.gov.au/-/media/Spectrum-Engineering/Information/Word-Document/RALI-MS33.docx?la=en>
11. Recommendation ITU-R P.525-2, “Calculation of Free-space Attenuation”.
12. Recommendation ITU-R P.452, “Prediction procedure for the evaluation of microwave interference between stations on the surface of the Earth at frequencies above about 0.7 GHz”.
13. 3.4 GHz Spectrum Licence Technical Framework – Marketing Plan
http://www.acma.gov.au/Industry/Spectrum/Spectrum-planning/About-spectrum-planning/technical-framework-3_4-ghz
14. 2 GHz Spectrum Licence Technical Framework – Section 145 Determination.

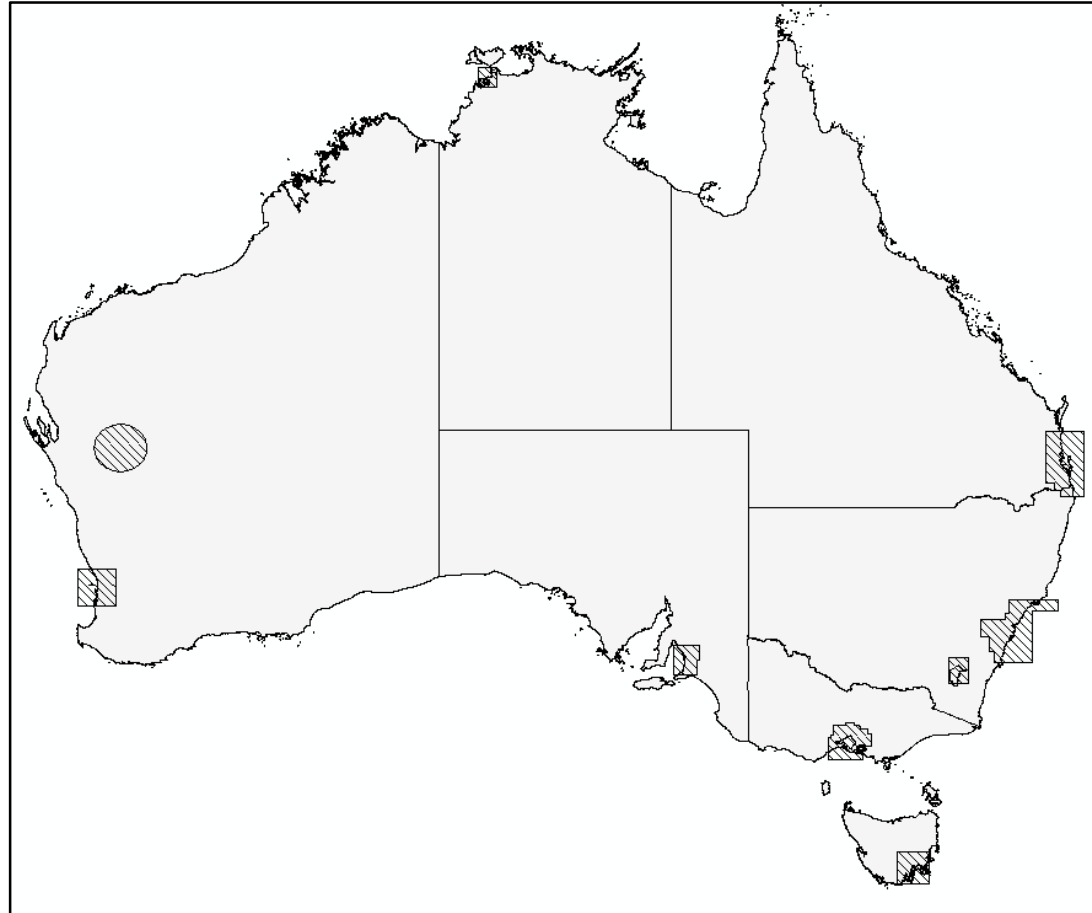
<http://www.acma.gov.au/Industry/Spectrum/Spectrum-planning/About-spectrum-planning/technical-framework-2-ghz>

15. *Radiocommunications (Interpretation) Determinations 2015.*

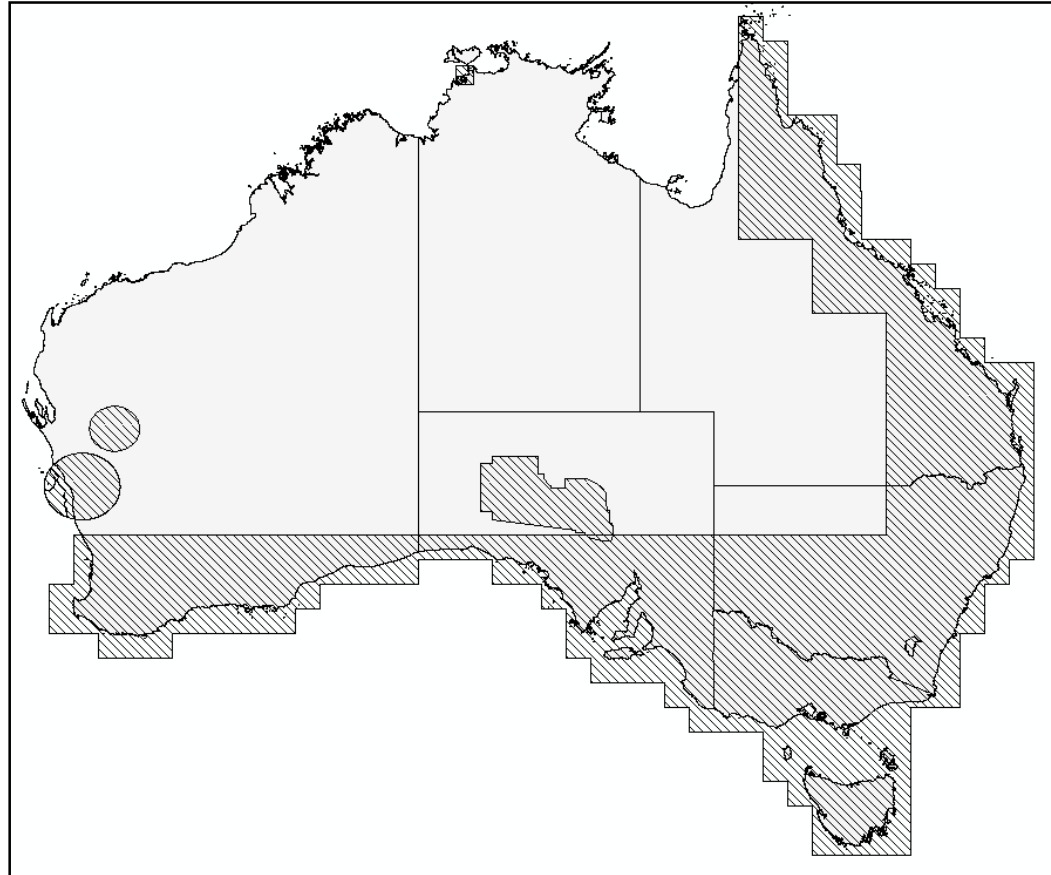
<https://www.legislation.gov.au/Details/F2016C00284>

16. *Radiocommunications Licence Conditions (Apparatus Licence) Determination 2015.*

<https://www.legislation.gov.au/Details/F2015L00210>

Attachment 1a: Permitted deployment areas: 1900-1920 MHz band apparatus licensed BWA

Apparatus licensed BWA services may only be licensed in the areas outside the shaded areas. For precise definition of area boundaries refer to *Radiocommunications (Spectrum Re-allocation) Declaration No. 2 of 2000*.

Attachment 1b: Permitted deployment areas: 3575-3700 MHz band apparatus licensed BWA

Apparatus licensed BWA services may only be licensed in the areas outside the shaded areas. For precise definition of area boundaries refer to *Radiocommunications Assignment and Licensing Instruction (RALI) MS03: Spectrum Embargoes*. Note that only the frequencies from 3600-3700 MHz band are embargoed inside the Woomera Prohibited Area.

Attachment 2a: Protection Criteria: 1900-1920 and 3575-3700 MHz band BWA receivers

PROTECTION CRITERIA

For the purposes of this attachment adjacent channels are defined with respect to the victim receiver’s channel size. For example, in the case of an interference assessment for a point-to-point transmitter using a 14 MHz channel into a BWA receiver using a 5 MHz channel, the first adjacent channel refers to the 5 MHz channels either side of the victim receiver’s occupied channel. The same logic is used to determine 2nd and 3rd adjacent channels.

1. Victim BWA receiver and Interfering 1.8 GHz or 2.1 GHz Fixed link transmitter

Frequency Offset (MHz)	PROTECTION CRITERIA Digital Interferer Tx → Digital Victim Rx
Co-channel	-102 (dBm per 5 MHz channel) -99 (dBm per 10 MHz channel) -96 (dBm per 20 MHz channel)
1 st Adjacent Channel	- 72 (dBm per 5 MHz channel) -69 (dBm per 10 MHz channel) -66 (dBm per 20 MHz channel)
2 nd Adjacent Channel	

2. Victim BWA receiver and Interfering 3.8 GHz Fixed link transmitter

Frequency Offset (MHz)	PROTECTION CRITERIA Digital Interferer Tx → Digital Victim Rx
Co-channel	-99 (dBm per 10 MHz channel) -97.2 (dBm per 15 MHz channel) -96 (dBm per 20 MHz channel) -94.2 (dBm per 30 MHz channel)
1 st Adjacent Channel	- 69 (dBm per 10 MHz channel) -67.2 (dBm per 15 MHz channel) -66 (dBm per 20 MHz channel) -64.2 (dBm per 30 MHz channel)
2 nd Adjacent Channel	

3. Victim BWA receiver and Interfering Amateur Repeater

Frequency Offset (MHz)	PROTECTION CRITERIA Digital Interferer Tx → Digital Victim Rx
Co-channel	-99 (dBm per 10 MHz channel) -97.2 (dBm per 15 MHz channel) -96 (dBm per 20 MHz channel)
1st Adjacent Channel	-69 (dBm per 10 MHz channel) -67.2 (dBm per 15 MHz channel) -66 (dBm per 20 MHz channel) -64.2 (dBm per 30 MHz channel)

4. Victim BWA receiver and Interfering BWA transmitter (Note a)

Frequency Offset (MHz)	PROTECTION CRITERIA Digital Interferer Tx → Digital Victim Rx
Co-channel	-99 (dBm per 10 MHz channel) -97.2 (dBm per 15 MHz channel) -96 (dBm per 20 MHz channel) -94.2 (dBm per 30 MHz channel)
1st Adjacent Channel	

- a. This only applies for protection between stations of different licensees, where a minimum separation distance of 30 km between base stations is applicable. No minimum separation distance applies to stations operated by the same licensee. In such cases, it is expected that the licensee would manage any self interference between stations.

5. Victim BWA receiver and Interfering Spectrum Licence Device

BWA receivers are to be protected to a level -115 dBm/ 1 MHz. This is based on a receiver noise floor of -109 dBm/1 MHz and an I/N of – 6 dB.

Unless a more accurate mask can be obtained, the following notional receiver mask should be used in assessing interference:

- a selectivity of 45 dB between 0 and 5 MHz offset* (based on Adjacent Channel Selectivity criteria); and
- a selectivity of 53 dB for offsets* greater than 5 MHz (based on in-band Blocking criteria)

*Note: Offset is the frequency separation between the edge of the transmitter’s occupied bandwidth and the P-MP receiver licence channel edge

The methodology for determining the frequency dependent rejection (FDR) ratio can be obtained from ITU-R SM.337-6.

Attachment 2b: Protection Criteria: 1.8, 2.1 and 3.8 GHz fixed point-to-point receivers

PROTECTION RATIOS

For the purposes of this attachment adjacent channels are defined with respect to the victim receiver’s channel size. For example, in the case of an interference assessment of a BWA transmitter using a 5 MHz channel into a point-to-point receiver using a 14 MHz channel, the first adjacent channel refers to the 14 MHz channels either side of the victim receiver’s occupied channel. The same logic is used to determine 2nd and 3rd adjacent channels.

1. Victim 1.8 GHz, 2.1 GHz and 3.8 GHz fixed link receiver and Interfering BWA

Frequency Offset (MHz)	REQUIRED PROTECTION RATIO (dB) Digital Interferer Tx → Digital Victim Rx
Co-channel	60
1 st Adjacent Channel	30
2 nd Adjacent Channel	0
3 rd Adjacent Channel	

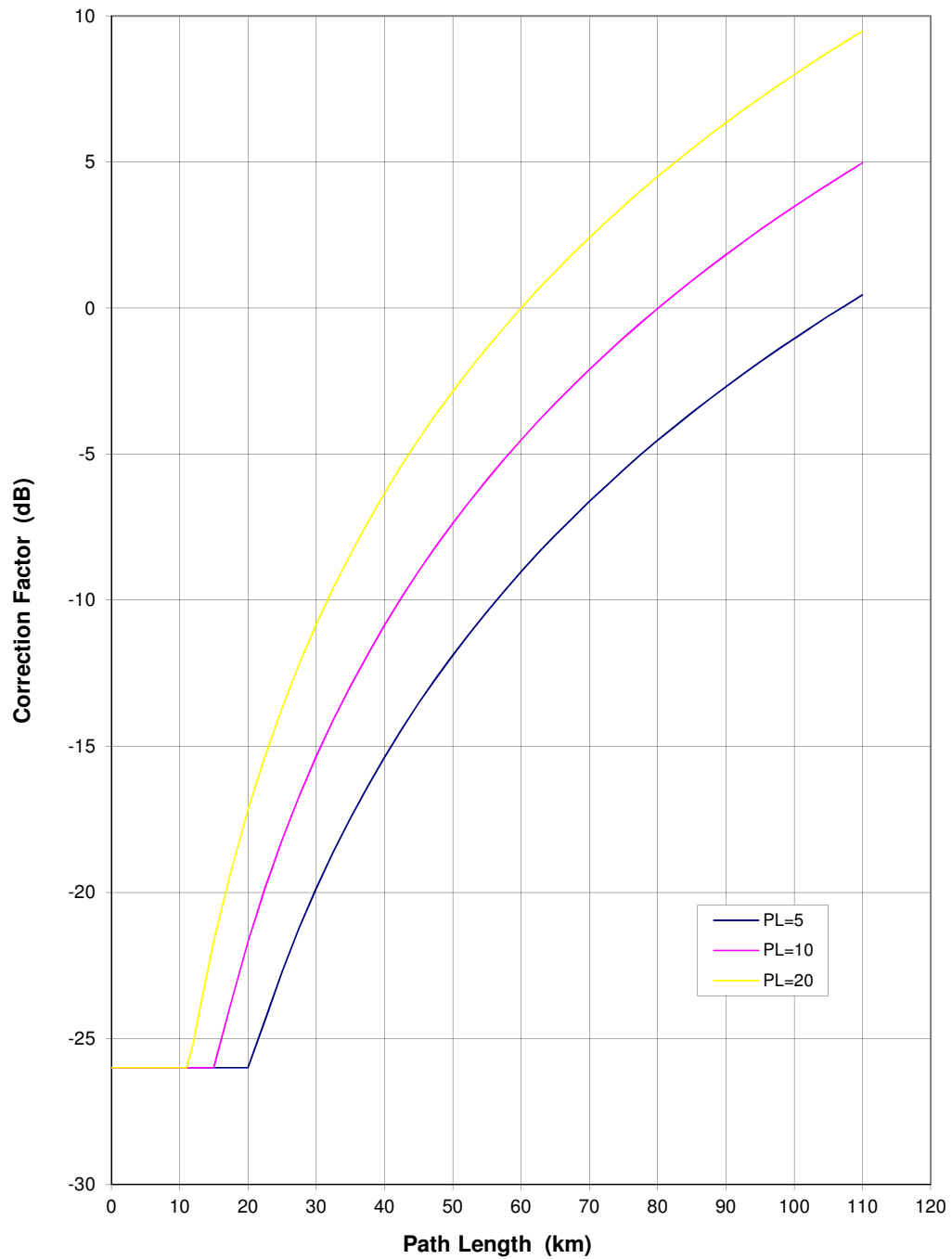
Notes:

1. Protection ratios are based on a 60 km path length and P_L (Percentage of time that the average refractivity gradient in the lowest 100 m of the atmosphere is less than or equal to -100 N units/km) of 20. For other path lengths and P_L values refer to the correction factor graph at Attachment 2c.
2. Separate protection ratios for analog victims have not been defined. The above-mentioned protection ratios for digital systems shall be applied in such cases.

3. Provisionally, protection ratio values quoted here are identical to those included in RALI FX-3 for comparable cases. However, assigners should be advised that in future these values (and the comparable values in RALI FX-3) may be revised downward to increase the density of spectrum usage in these bands.

Attachment 2c: Protection Ratio correction factors

MULTI PATH



P_L : Percentage of time that the average refractivity gradient in the lowest 100 m of the atmosphere is less than or equal to -100 N units/km.

For further details refer to Annex A to Appendix 1 of RALI FX-3.

Attachment 2d: Protection Criteria: 3600-4200 MHz band Earth Station receivers

1. Victim Earth Station (operating in 3700-4200 MHz) and Interfering BWA (Note a)

Guard band ^b (MHz)	PROTECTION CRITERIA Digital Interferer Tx → Digital Victim Rx
< 10	-110.1 (dBm per 1 MHz)
≥10	Minimum 20 km separation distance applies

- a. Here guard band is defined as the frequency separation between the upper frequency limit of the BWA channel and the lower frequency of the Earth stations receive bandwidth.

2. Victim Earth Station (operating in 3600-3700 MHz) and Interfering BWA (Refer to notes b & c)

Frequency Offset (MHz)	PROTECTION CRITERIA Digital Interferer Tx → Digital Victim Rx
Co-channel	Short term (0.0017% time) : -121.4 (dBm per 1 MHz) Long Term (20% time) : -130.1 (dBm per 1 MHz)
Adjacent Channel	Note c

- b. Co-channel coordination is to be conducted for both long and short term protection criteria, using the propagation model defined in ITU-R Recommendation P.452 and the 'per MHz' approach described in Attachment 5.
- c. Since Earth Stations operating in the 3600-3700 MHz band are currently located exclusively in Perth and Sydney, adjacent channel coordination is not required as the currently defined embargo 42 areas are considered large enough to provide adequate protection.

Attachment 3: BWA system model

Equipment types

The equipment types and technologies considered in developing this RALI were:

- IEEE 802.16a “Air Interface for Fixed Broadband Wireless Access Systems” A TDD/FDD system supporting point-to-multipoint and mesh network. TDD single frequency systems utilising OFDM/OFDMA. This also includes the amendments 802.16d and 802.16e. WiMAX systems will operate using this technology.
- HIPERMAN under the European BRAN (Broadband Radio Access Networks) project. It is similar to IEEE 802.16 (OFDM) for bands under 11 GHz. Parameters relevant to the technical framework as in the ETSI standard ETSI TS 102 177.
- UMTS UTRA TDD. A TDD single frequency CDMA system supported in the 2 GHz spectrum auctions for IMT2000/3G. Relevant standards are ETSI TS 125 105 (base station) and ETSI TS 125 102 (user equipment).

Deployment model and general equipment characteristics

Deployment model values were chosen after considering typical BWA parameter values. The cell radius value (within which remote stations will be protected under the constraints of the deployment model) was chosen to provide a reasonable protected deployment area but at the same time to promote opportunities for frequency re-use in other areas (by not protecting weak edge-of-coverage signals).

Base station Parameters	Deployment model Value	Range	Unit
Transmit Power	20	4 - 20	W
Feeder Loss	2	2	dB
Antenna Gain	19	11 - 19	dBi
F/B	28	0 - 30	dB
EIRP	60	45 – 60	dBm
Rx Bandwidth	5	5	MHz
Rx Noise Floor	-102	-100 → -102	dBm/5MHz
Antenna Height	30	variable	m
Maximum Cell Radius ¹⁷	15	from 10 -30	km
Adaptive Transmit Power Control	enabled	not specified	

¹⁷ Cell radius for cases where the base station communicates with remote stations with external antennas. While practical systems may in some cases achieve greater ranges, such operation is regarded as fortuitous and will not be afforded protection. Similarly such operation will be subject to a “no interference” condition in respect of interference to other licensed services.

Remote station parameters	Deployment model Value	Range	Unit
Transmit Power	0.25	0.25 - 1	W
Feeder Loss	0	0	dB
Antenna Gain	14	0 – 18	dBi
F/B	25	0 – 25	dB
XPD	17*	20-24	dB
EIRP	38	24 - 48	dBm
Rx Bandwidth	5	3.5-10	MHz
Rx Noise Floor	-102	-100 → -102	dBm/5MHz
Antenna Height	6	1.5 – 6	m

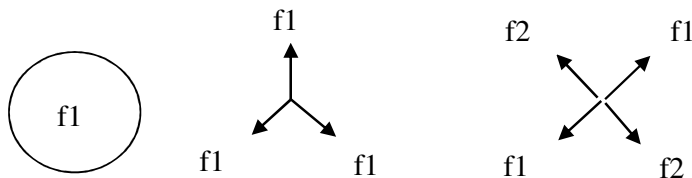
* The XPD is measured along the antenna boresight and reduces as the angle away from boresight increases. To account for this a value slightly less than the specified typical range is used. XPD is not available for systems using mixed polarisation.

Notional Remote Station

Maximum transmit power	250 mW (24 dBm)
Maximum antenna gain	14 dB
XPD	17 dB
Feeder Loss	0 dB
Maximum height	No higher than the base station antenna height ASL
Maximum cell radius	15 km

Deployment scenarios

It is expected that, in most cases, base stations will be deployed in a manner that provides 360° coverage around the base site. This could be achieved using an omnidirectional antenna or a combination of sectorized antennas as follows:

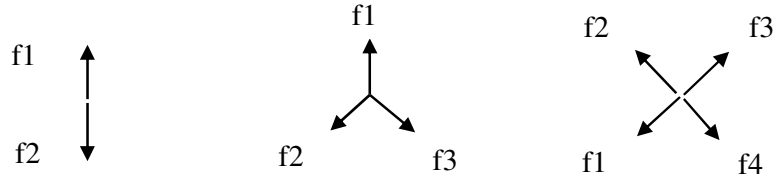


Single channel configurations

Two channel configuration

In these cases the base station is expected to be the dominant element when considering interference to and from other services. That is the remote stations need not be considered in the coordination process, as the coordination with the base station will provide protection to and from the remote stations.

However, in the deployment scenarios shown below, it is possible that the remote station could have a greater interference potential due to the front-to-back characteristics of the base station antenna. In such cases, explicit protection from interference is not given to remote stations. The onus is on operators to ensure remote stations do not cause and do not receive harmful interference.



Channel configuration where remote station may be worst-case for protection

Emission Masks

Emission characteristics should conform to the relevant standard paying particular attention to co-existence requirements. See Annex 1 of this attachment for criteria specific to the 3575-3700 MHz band.

Protection Criteria

Unlike fixed link protection ratios, which until now have been conservatively based and in many cases provide considerable excess fade margin, the BWA protection criteria in this RALI are deliberately biased towards permitting a high level of spectrum re-use while affording reasonable – though not excessive – levels of protection to the notional BWA service areas.

The maximum unwanted signal level for BWA receivers has been based on a level equivalent to the noise floor of the receiver (with an assumed receiver system noise Figure of 5 dB and noise temperature of 290 K). Within a nominal 5 MHz channel this level is –102 dBm. This provides an interference-to-noise ratio of 0 dB (i.e. $I/N = 0$ dB).

A summary of the protection levels for numerous common bandwidths is provided in the table below. This list is not exhaustive, due to the potential for scalable operational bandwidths of many BWA devices.

Reference Bandwidth (MHz)	Protection Criteria (dBm/Ref BW)
1	-109
5	-102
10	-99
20	-96
30	-94.2

ANNEX 1: 3575-3700 MHz Band Specific Requirements

1.1 Summary of requirements

Smart Antennas	<ul style="list-style-type: none">• Coordination is to be conducted based on the highest achievable gain of a system
EIRP density limits (dBm/MHz)	<ul style="list-style-type: none">• 3575-3680 MHz: 51 dBm/MHz• 3680-3700 MHz: 30 dBm/MHz
Emission Masks	<ul style="list-style-type: none">• All transmitters are to adhere to relevant emission masks stated in ETSI EN 302 326;• At the both the 3575 and 3700 MHz boundaries, base stations are to adhere to the band edge mask detailed in this annex.
Deployment Constraints	<ul style="list-style-type: none">• No base stations may be deployed within 20 km of an Earth station operating in the 3700-4200 MHz band unless agreement can be made with the Earth station licensee;• No remote stations are to be deployed within a 2 km radius of an Earth station operating in the 3700-4200 MHz band – unless agreement can be made with the Earth station licensee;• no transmitters may be placed inside embargo areas;• operators may only deploy user terminals and remote stations that employ ‘listen before talk’, this means these devices can only operate if they receive and can positively decode a signal from a BWA base station;• BWA operators are required to take into account other licensed services when deploying user terminals, particularly when deploying along or near the main beam azimuth;• user terminals will operate under a ‘no interference/no protection’ basis.

In the event that interference occurs after a licence is issued and the issue cannot be resolved between the affected parties, licensees can expect the ACMA to have regard to this RALI and relevant legislative instruments in dealing with the dispute. The ACMA will also pay particular attention to the *Specific Requirements* outlined in this Annex for licences issued in the 3575-3700 MHz band.

1.2 Deployment Constraints

It is the responsibility of the BWA licensee to take reasonable action to ensure that remote stations do not cause harmful interference to another licensed service. To this end BWA station deployment constraints have been created to help reduce the chance of interference from BWA user terminals (including mobile/nomadic) and base stations into other licensed services.

In the event that interference is caused by a remote station deployed by a licensee, remedial action is required to be taken. If modifications to the transmitter or agreement with affected parties cannot be achieved to resolve an interference issue, the licensee will be required to cease transmissions from the remote station.

1.3 Out-of-band Emission Limits

BWA transmitters (both base and remote stations) in the 3575-3700 MHz band shall comply with the applicable out-of-band spectrum density masks as detailed in ETSI EN 302 326-2. Licensees are required to take reasonable steps to ensure that any device operating on their networks comply with this standard.

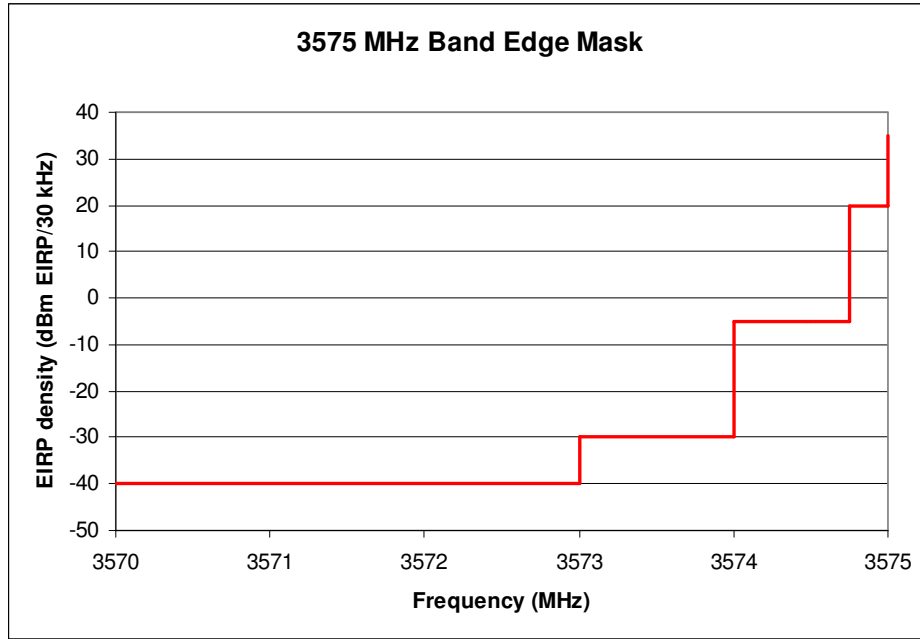
In addition, band edge masks are specified at both the 3575 MHz and 3700 MHz frequency boundaries. It is a requirement that all BWA base stations adhere to the band edge masks specified here, and ensure that emissions leaving the band adhere to the required levels.

3575 MHz Boundary Emission Mask

In order to enable effective co-existence with the adjacent band spectrum licence space, BWA base stations operating in the 3575-3700 MHz band are required to comply with the following band-edge mask specified at the 3575 MHz frequency boundary. The mask resembles the out-of-band emission limits specified in the 3.4 GHz Spectrum Licence Technical Framework – Marketing Plan. The band-edge mask is described as follows:

The equivalent isotropically radiated power (EIRP) of BWA base stations shall not exceed the following levels below the 3575 MHz band edge:

- (a) +20 dBm *eirp* per 30 kHz within the range 3574.75 MHz to 3575 MHz;
- (b) -5 dBm *eirp* per 30 kHz within the range 3574 MHz to 3574.75 MHz;
- (c) -30 dBm *eirp* per 30 kHz within the range 3573 MHz to 3574 MHz; and
- (d) -40 dBm *eirp* per 30 kHz lower than 3573 MHz.



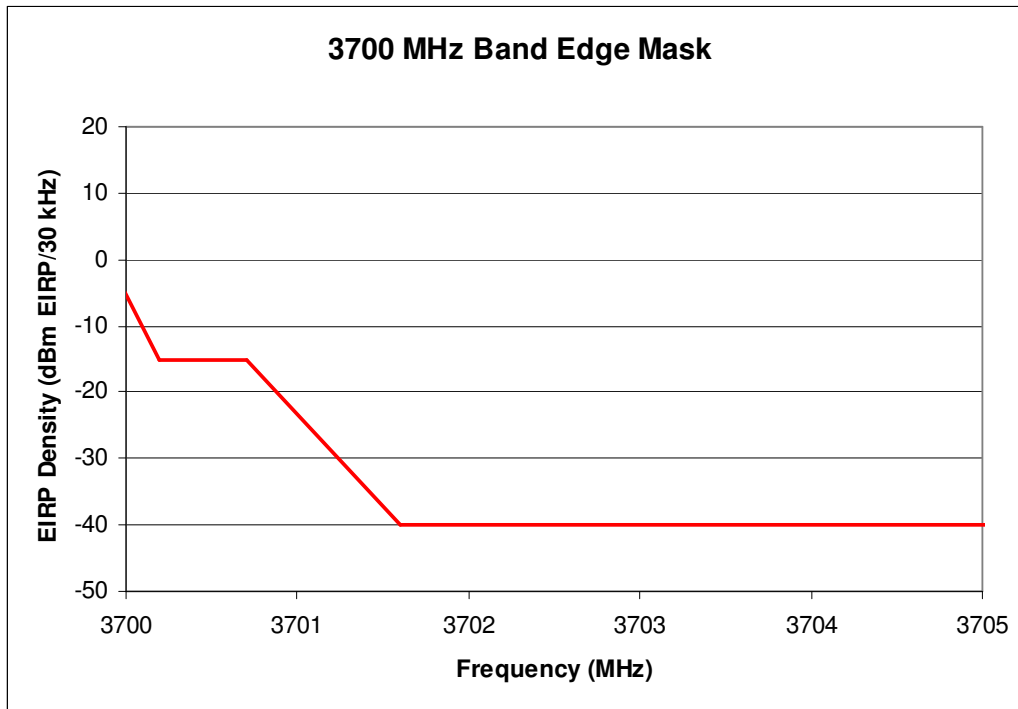
3700 MHz Boundary Emission Mask

In order to enable effective co-existence with adjacent channel licensed earth stations, BWA base stations operating in the 3575-3700 MHz band are required to comply with the following band-edge mask specified at the 3700 MHz frequency boundary. The band-edge mask is described as follows:

The equivalent isotropically radiated power (EIRP) of BWA base stations shall not exceed the following levels at and above the 3700 MHz band edge:

- (e) -5 dBm in the 30 kHz bandwidth within the frequency range 3700-3700.03 MHz;
- (f) -15 dBm measured in any 30 kHz bandwidth in the frequency range 3700.2-3700.7 MHz; and
- (g) -40 dBm measured in any 30 kHz bandwidth at any point above the frequency 3701.6 MHz.

For frequencies between the ranges defined by (e) and (f), or (f) and (g) the EIRP shall not exceed the level defined by a straight line joining the levels specified in (e), (f) and (g).



Attachment 4: Co-channel – BWA transmitter within 200 km of a spectrum licence boundary

This coordination procedure deals with an apparatus licensed BWA transmitter at a high site potentially interfering with a spectrum licensed receiver also located at a high site. In most cases this will be the worst-case interference situation.

To determine whether coordination is required a coordination threshold distance is used. The coordination threshold distance for a BWA transmitter in this RALI is 200 km; that is if the proposed BWA transmitter is located within 200 km of a spectrum licence boundary then coordination is required. This condition could occur if 1900-1920 MHz or 3575-3700 MHz band BWA systems are located within 200 km of major city spectrum licence boundary. Proposed BWA transmitters or receivers outside this distance should not require coordination with spectrum licences.

The device boundary is calculated according to the distance that is necessary to satisfy the following device boundary criterion. The same general procedure as specified in the [Radiocommunications \(Unacceptable Levels of Interference - 3.4 GHz Band\) Determination 2015](#) applies. However, this criterion does not have to be satisfied if the licensee has an agreement with the licensee(s) of a spectrum licence whose geographic area is intersected by the radials and whose frequency band contains the effective occupied bandwidth of the transmitter, to operate transmitters that do not comply with this device boundary criterion.

The device boundary criterion is:

$$(HRP - Lb - CR) \leq 0;$$

where HRP = Horizontally Radiated Power; and

Lb = Propagation Loss; and

CR = Compatibility Requirement for a notional receiver.

Calculation of Horizontally Radiated Power (HRP)

HRP is the horizontally radiated power for each radial.

Note that there is a cap on HRP of:

- 55 dBm EIRP per 30 kHz for transmitters operating under spectrum licences in the 1900-1920 MHz band.
- 51 dBm EIRP per MHz for transmitters operating under spectrum licences in the 3575-3700 MHz band.

High Site-High Site Propagation Model (Lb)

The propagation loss for a high site-high site transmit-receive path (Lb) may be worked out in accordance with the general method for estimating diffraction loss described in ITU-R Recommendation P.526.

Coordination Level

The level of protection for notional receivers (typically a spectrum licensed base station) in the 1900-1920 MHz band is -126 dBm/30 kHz. The notional receiver should be set 30m above ground level and have a total gain of 19 dBi in all directions, including feeder losses.

The level of protection for notional receivers (typically a spectrum licensed base station) in the 3575-3700 MHz band is -115 dBm/1 MHz. The notional receiver should be set 30m above ground level and have a total gain of 17 dBi in all directions, including feeder losses, for non Active Antenna Systems or have a peak traffic beam gain of 24 dBi, including feeder losses, for Active Antenna Systems.

Attachment 5: Coordination of BWA licences with Earth Stations

Coordination of a BWA transmitter with an Earth Station receiver operating in the 3600-4200 MHz takes into account three potential interference mechanisms:

- co-channel interference;
- adjacent channel interference; and
- receiver overload/saturation and non-linear operations.

It should be noted that the coordination criteria provided in this RALI between Earth Stations operating in the 3600-4200 MHz band and BWA systems are considered preliminary and may be updated in the future depending on factors such as:

- the demand for BWA in regional and remote areas; or
- a review on the effectiveness of the preliminary coordination arrangements; or
- the finalisation of studies being conducted on sharing between BWA and the FSS by ITU-R Working Parties 4A and 5A.

Coordination Requirements

A summary of Earth Station parameters used in developing sharing criteria and to be used during coordination is provided in the table below.

Parameter	Value
Antenna Pattern	ITU-R Recommendation S.465-5
Antenna Feeder Losses	0 dB
Minimum elevation angle	5° – earth stations using lower elevation angles will only be offered protection to a level of 5°.
System Temperature	70 K
Noise Floor	-120.1 dBm/MHz
Protection Criteria (I/N)	Short term (0.0017% time) = -1.3 dB Long Term (20% time) = -10 dB (Based on ITU-R Recommendations S.1432 and SF.1006)
Onset of non-linear operation Level	-65 dBm
Filter Attenuation Assumption ¹⁸	3670-3700 MHz → 0 dB < 3670 MHz → ≥15 dB
Other characteristics	All other characteristics are taken from individual licence details contained in the Register of Radiocommunications Licences (RRL).

¹⁸ Earth Stations operating in the 3700-4200 MHz band will not be afforded protection from interference

Co-channel coordination

Co-channel coordination is to be conducted for both long and short term protection criteria, using the propagation model defined in ITU-R Recommendation P.452 using worst month parameters under clear sky conditions and the 'per MHz' approach described later in this Attachment.

It is considered that successful co-channel coordination of a BWA base station with an Earth Station receiver implies adequate protection against user terminal interference.

Adjacent Channel Coordination with Earth Stations operating in the 3700-4200 MHz band

For adjacent channel coordination between BWA stations and Earth Stations operating in the 3700-4200 MHz band, a minimum 20 km separation distance is implemented. Under most circumstances, adherence to this minimum separation distance implies that protection from adjacent channel interference and saturation (or non-linear operations) is adequately met. The minimum separation distance has been developed considering:

- BWA station EIRP density restrictions in the 3670-3700 MHz frequency range;
- long term protection requirements of Earth Stations;
- Earth Stations operating in the 3700-4200 MHz band will use RF filters with a minimum attenuation performance of greater than or equal to 15 dB below 3670 MHz;
- an assumed typical operating range for mobile and nomadic devices of 1-3 km from the base station; and
- an assumed cell size of up to 15 km for BWA base stations. It is noted that cell sizes may vary, depending on the environment, and that most fixed user terminals will be located within 10 km of the base station. Larger cell sizes may be possible with a combination of line of sight paths, high gain antenna, high sites and lower modulation schemes. For larger cell sizes, protection to Earth stations is afforded through the deployment constraints detailed in attachment 3.

Situations where the 20 km separation distance may not be valid occur when the guard band between a BWA station and Earth Station is less than 10 MHz. Here guard band is defined as the frequency separation between the upper frequency limit of the BWA channel and the lower frequency of the Earth station receive bandwidth. This situation can only occur for BWA stations operating in the frequency range 3670-3700 MHz.

For situations when the guard band between services is <10 MHz detailed case-by-case coordination is required, with a minimum separation distance of 20 km still

occurring from BWA stations operating in the 3.6 GHz band unless a filter with performance equal to or better than that specified here is installed..

applying. Given the band edge mask specified at the 3700 MHz boundary (as described in attachment 3), as well as the EIRP restrictions in the 3670-3700 MHz frequency range, it is noted that worst case interference may occur from a remote station.

To account for this situation coordination is performed assuming an omni directional antenna at the same location as the base station, at the same height using the same antenna and EIRP. A 20 dB net filter discrimination (NFD) is further assumed during coordination. Given the long-term protection criteria for Earth Stations of -130.1 dBm/MHz, required protection criteria for Earth stations including the 20 dB NFD is -110.1 dBm/MHz (this level is specified in Attachment 2d). Coordination is conducted on a 'per MHz' basis as described later in this attachment.

Adjacent Channel Coordination with Earth Stations operating in the 3600-3700 MHz band

Earth Stations operating in the 3600-3700 MHz band are currently exclusively located at various locations in Perth and Sydney. Relevant embargo areas defined in *Radiocommunications Assignment and Licensing Instruction (RALI) MS03: Spectrum Embargoes* are considered large enough to protect Earth station operating at these locations from adjacent channel interference and receiver overload/saturation (or non-linear operations). Therefore adjacent channel coordination is not required between BWA stations and Earth Stations operating in the 3600-3700 MHz band.

Definition of 'Per MHz' Protection of Earth Stations

The Per MHz protection outlined in this section is used for interference calculation between BWA transmitters and Earth station receivers. It is suggested that this procedure be used to protect Earth stations due to the potential for interference to occur across the entire reception bandwidth.

This methodology also adequately addresses extended C-band (3600-3700 MHz) licensees that have licensed bandwidths in the order of a few hundred megahertz. These large bandwidth licences are used for the reception of numerous signals of smaller bandwidth, which can be received in multiple dishes. Under these conditions, calculating the noise floor, and subsequently the interference threshold, over the entire licensed bandwidth would not provide a sufficient level of protection to Earth stations. The 'per MHz' approach adequately addresses this situation.

Example 'per MHz' coordination process

Input data:

Earth Station Centre Frequency	=	3.6195 GHz
Earth Station Bandwidth	=	29 MHz
Earth Station Interference Threshold	=	-160.1 dBW/MHz (long term)
	=	-151.4 dBW/MHz (short term)

BWA Station Centre Frequency = 3.635 GHz
 BWA Station Bandwidth = 10 MHz
 BWA Station EIRP = 20 dBW/10 MHz

Co-channel Coordination Procedure:

1. Firstly it needs to be determined if there is co-channel overlap between the occupied BWA channel and the receive bandwidth of the Earth Station. A pictorial of the example provided is given below:

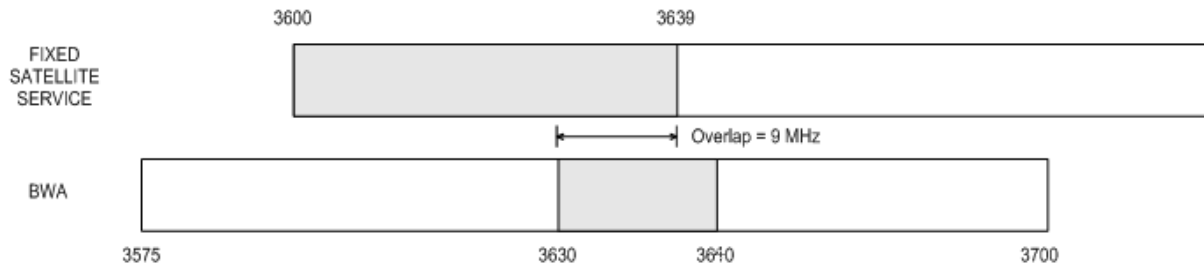


Figure 2a. Visualisation of co-channel overlap between a proposed BWA station and existing Earth Station

2. If there is co-channel overlap then the EIRP of the BWA transmitter is converted to a EIRP density per 1 MHz level. An example of this is given below:

$$\begin{aligned}
 \text{BWA Station EIRP (dBW/MHz)} &= 20 \text{ dBW/10MHz} - 10\log(\text{bandwidth}) \\
 &= 20 \text{ dBW/10MHz} - 10\log(10) \\
 &= 10 \text{ dBW/MHz}
 \end{aligned}$$

3. This per MHz level is then used to coordinate with the relevant Earth station coordination criteria, all of which are referenced in 1 MHz bandwidths. Coordination is carried out using both long and short term criteria and the ITU-R Recommendation P.452 propagation model using worst month parameters under clear sky conditions.