Radiocommunications Advisory Guidelines (Managing Interference from Transmitters — 2.3 GHz Band) 2009[1]

Radiocommunications Act 1992

The AUSTRALIAN COMMUNICATIONS AND MEDIA AUTHORITY makes these Advisory Guidelines under section 262 of the *Radiocommunications Act 1992*.

Dated 3rd February 2009

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Background

The 2.3 GHz spectrum licence sets out the spectrum licensing requirements for the operation of transmitters in the frequency band 2302–2400 MHz, updating and replacing previous spectrum licence requirements. The frequency band 2302–2400 MHz (once known as the Multipoint Distribution System (MDS) B band) was designated by the Minister for allocation by the issue of spectrum licences on 14 January 2000 throughout Australia.

Receivers of apparatus licensed and class licensed services have operated in adjacent frequency bands from well before the Minister's designation of the band and continue to do so. These receivers could suffer interference from unwanted emissions, blocking and intermodulation products, caused by transmitters operated under the spectrum licence.

Unwanted emissions are by-products of a transmitter's emissions and include broadband noise, harmonics, intermodulation products, transient signals and other spurious signals. Blocking occurs when a high level off-tune signal overloads a receiver's front-end and causes degradation in the quality of the wanted output signal.

Intermodulation products can be generated in-band in the input stages of receivers in the presence of two or more high level signals at the receiver input. These Advisory Guidelines have been made for the management of these three types of interference to receivers operating in and adjacent to the 2.3 GHz band including the following:

(a) fixed services including point-to-point fixed links authorised by apparatus licences operating in spectrum adjacent to the 2.3 GHz spectrum licence band;

(b) mobile services including aeronautical telemetry systems operating in the frequency band 2200–2300 MHz adjacent to the 2.3 GHz spectrum licence band;

(c) space services including space research systems receiving signals from deep space in the spectrum below the 2.3 GHz spectrum licence band;

(d) receivers operating with transmitters authorised for use under class licences in the frequency band 2400–2483.5 MHz immediately above the 2.3 GHz spectrum licence band.

These Advisory Guidelines also provide advice regarding the protection of radio-astronomy services operating in the frequency band 2200–2550 MHz on an opportunistic basis and to the Mid West Radio Quiet Zone in Western Australia.

As radio waves propagate in different ways because of factors such as frequency, terrain, atmospheric conditions and topography, there are a number of ways to predict path loss, in addition to those discussed in RALI FX-3. Some suitable propagation models appropriate to the band and various system types are set out in Schedule 1.

Part 1 Preliminary

1.1 Name of Advisory Guidelines

These Advisory Guidelines are the *Radiocommunications Advisory Guidelines (Managing Interference from Transmitters — 2.3 GHz Band) 2009*.

1.2 Commencement

These Advisory Guidelines commence on the same day as the *Radiocommunications Spectrum Marketing Plan (2.3 GHz Band) 2009*.

1.3 Purpose of Advisory Guidelines

(1) The purpose of these Advisory Guidelines is to manage interference from transmitters operated under the 2.3 GHz spectrum licence to provide for the protection of receivers operating in or adjacent to the frequency band 2302–2400 MHz.

(2) ACMA will take these Advisory Guidelines into account in determining whether a spectrum licensed transmitter is causing interference to a licensed receiver operating as set out in these Advisory Guidelines.

(3) These Advisory Guidelines do not prevent a licensee negotiating other protection requirements with another licensee.

1.4 Interpretation

(1) In these Advisory Guidelines:

ACMA means the Australian Communications and Media Authority.

Act means the *Radiocommunications Act 1992*.

ITU means the International Telecommunication Union.

ITU Recommendation means a Recommendation made by the ITU.

RALI FX-3 means the Radiocommunications Assignment and Licensing Instruction No. FX-3 issued by ACMA, as in force from time to time.

Note Copies of RALI FX-3 are available from ACMA.

RALI MS-25 means the Radiocommunications Assignment and Licensing Instruction No. MS-25 issued by ACMA, as in force from time to time.

Note Copies of RALI MS-25 are available from ACMA.

section 145 determination means the *Radiocommunications (Unacceptable Levels of Interference 2.3GHz Band) Determination 2009*.

(2) A term used in these Advisory Guidelines that is defined in the section 145 determination has the same meaning as in that determination.

Note The following terms used in these Advisory Guidelines have the meaning defined in the Act:

- frequency band
- interference
- spectrum licence
- transmitter.

1.5 Propagation models

The propagation models set out in Schedule 1 may assist in establishing the protection requirements in these Advisory Guidelines.

Part 2 Fixed service receivers

2.1 Background

(1) This Part applies to the protection of receivers in systems operating as part of the Fixed Service in spectrum in and adjacent to the 2.3 GHz spectrum licence band.

(2) Channelling arrangements for point-to-point fixed link systems that need to be considered are:

(a) The "2.1 GHz channelling plan", which supports use by medium capacity fixed point-to-point links in line with Recommendation ITU-R F.382. The band operated from just below 1900 MHz to about 2300 MHz and contained 6 main and 6 interleaved 29 MHz channels with a 213 MHz paired spacing;

(b) the Recommendation ITU-R F.1098 channelling plan introduced by ACMA to assist in the relocation of the 2.1 GHz channels. Channels adjacent to the 2302 MHz spectrum licence boundary need to be considered in the interference management framework.

(3) The point-to-point fixed link systems in the above bands are assigned in accordance with the frequency assignment criteria set out in RALI FX-3. This document provides details of the channel plans for individual microwave bands and guidance on interference criteria and frequency coordination between links to achieve certain performance objectives. It provides assignment criteria for each frequency band and specifies protection ratios. The criteria are typically based on internationally accepted ITU Recommendations.

(4) RALI FX-3 is subject to continuous review in consultation with industry, to incorporate improved assignment techniques and changing technology requirements. As revisions seek to improve spectrum access opportunities, without undue detriment to current licensees, users of the RALI are urged to consult the current version when planning systems to increase spectrum productivity. The latest version of RALI FX-3 is available from the ACMA website.

(5) There are a small number of apparatus licensed point-to-multipoint fixed link systems operating in remote parts of Australia in the frequency band 2300–2400 MHz. These systems should be considered to have the same receiver performance characteristics as 2.3 GHz band spectrum licence receivers.

2.2 Protection requirements

(1) Protection requirements for point-to-point fixed link systems are specified in RALI FX-3. In planning for the operation of transmitters under the spectrum licence, spectrum licensees are to provide the same level of out-of-band and in-band protection to point-to-point fixed link receivers as would be provided from apparatus licensed fixed service transmitters whose frequencies are assigned in accordance with RALI FX-3.

(2) The protection requirements for point-to-multipoint fixed link systems operating in the frequency band 2302–2400 MHz are the same as receivers operated under the 2.3 GHz band spectrum licence.

Part 3 Mobile service receivers

3.1 Background

This Part applies to the protection of receivers in systems operating as part of the Mobile Service in spectrum adjacent to the 2.3 GHz band spectrum licence. In this spectrum, the frequency band 2200–2300 MHz is currently used to support the use of aeronautical mobile telemetry systems.

3.2 Aeronautical mobile telemetry

The frequency band 2200–2300 MHz is used to provide telemetry from aeronautical mobile stations to aeronautical or terrestrial receivers. These stations are typically operated by the Department of Defence. These systems operate in specific areas around Australia and its territorial waters.

3.3 Protection requirements

Information regarding coordination and protection requirements for stations in this service is set out in spectrum planning report 10/01: Coordination Information for Defence Aeronautical Mobile Telemetry Systems Operating in the 2200 to 2300 MHz Frequency Range.

Note Spectrum planning report 10/01 is available on the ACMA website.

Part 4 Space services receivers

4.1 Background

This Part applies to the protection of receivers in systems operating as part of the Space Research, Space Operation and Earth Exploration Satellite services in spectrum adjacent to the 2.3 GHz spectrum licence band. Licensed receivers in these bands are protected in accordance with relevant ITU Recommendations.

4.2 Space services

(1) The frequency band 2200–2290 MHz is allocated to the Space Research, Space Operation and Earth Exploration Satellite and services for space to Earth and space to space communications. Earth stations operating in these services are located at the following places:

(a) Gnangara Road, Landsdale, Western Australia;

(b) Castray Esplanade, Battery Point, Tasmania;

(c) Tidbinbilla, Australian Capital Territory;

(d) New Norcia, Western Australia;

(e) Depot Hill Road, Yaragadee, 18.5 km north-west of Mingenew, Western Australia;

(f) CSIRO site, Alice Springs, Northern Territory;

(g) University of South Australia site, Mawson Lakes, South Australia.

(2) The frequency band 2290–2300 MHz is allocated to the Space Research service for deep space operations in the space to Earth direction using sensitive receivers. Earth stations in this service operate in:

(a) the Canberra region (at Tidbinbilla), Australian Capital Territory; and

(b) Parkes, New South Wales; and

(c) the region north of Perth (at Gnangara, New Norcia and Yarragadee), Western Australia.

4.3 Protection requirements

(1) Spectrum licensees are required to protect these Earth stations in accordance with the relevant ITU Recommendations. ACMA encourages direct liaison between spectrum licensees and the Earth station operators during the system planning phases of new systems. The protection requirements for space services receivers are set out in the following recommendations:

(a) Recommendation ITU-R SA.1154: Provisions to protect the space research (SR), space operations (SO), and Earth Exploration-satellite services (EES) and to facilitate sharing with the mobile service in the 2025–2110 MHz and 2200–2290 MHz bands;

(b) Recommendation ITU-R SA.363-5: Space operation systems. Frequencies, bandwidths and protection criteria;

(c) Recommendation ITU-R SA.1157-1: Protection criteria for deep-space research.

(2) Additional information regarding the calculation of appropriate coordination distances, propagation models and threshold coordination levels can be found in Appendix 7 of the ITU Radio Regulations for the determination of the coordination area around an Earth station in the frequency bands between 100 MHz and 105 GHz.

Part 5 Radio-astronomy service receivers

5.1 Background

(1) Spectrum licensees are requested to pay regard to radio-astronomy station receivers operating on frequencies in and adjacent to the 2.3 GHz spectrum licence band. A number of radio-astronomy facilities operate in bands of the Australian Radiofrequency Spectrum Plan carrying Australian footnote AUS87.

(2) The footnote indicates that there are facilities operated by the CSIRO at:

Item	Observatory	Location	Latitude	Longitude
1	Paul Wild Observatory	Narrabri	30° 59’ 52.084” S	149° 32’ 56.327” E
2	Parkes Observatory	Parkes	32° 59’ 59.8657” S	148° 15’ 44.3591” E
3	Mopra Observatory	Coonabarabran	31° 16’ 4.451” S	149° 5’ 58.732” E

(3) The footnote indicates that there are facilities operated by the University of Tasmania at:

Item	Observatory	Location	Latitude	Longitude
1	Mount Pleasant Observatory	Hobart	42° 48’ 12.9207” S	147° 26’ 25.854” E
2	Ceduna Observatory	Ceduna	31° 52’ 8.8269” S	133° 48’ 35.3748” E

(4) The footnote indicates that there are facilities operated at the Deep Space Communication Complex in Canberra (latitude 35° 23’ 54” S, longitude 148° 58’ 40” E).

5.2 Protection requirements

While these facilities operate on a fortuitous reception basis, ACMA would encourage the direct liaison of spectrum licensees with the radio-astronomy station operators, particularly during the system planning phases of new systems, to minimise the potential interference impact on these stations.

5.3 The Mid West Radio Quiet Zone

(1) The Mid West Radio Quiet Zone is located in central Western Australia at latitude 26° 42’ 15” S, longitude 116° 39’ 32” E. This site is currently protected by Embargo No. 41 and RALI MS32.

Note Copies of Embargo No. 41 and RALI MS32 are available from the ACMA website.

(2) An embargo represents a policy decision by ACMA to place restrictions on frequency assignments for apparatus licensed services in certain frequency bands and in certain geographical areas. These are necessary to minimise the dislocation of affected services and to allow for future developments. Details of Embargo No. 41 are available from the ACMA website.

Note ACMA intends to apply the policy objectives of Embargo No. 41 to spectrum licences in the 2.3 GHz band by means of additional licence conditions.

Part 6 Class licensed receivers

6.1 Background

(1) The general public are licensed to operate devices of similar characteristics and typically low interference risk via a number of different class licences made under the ACMA class licence framework. Currently there are two class licences that allow the operation of low interference potential devices such as wireless video senders, radiofrequency identification tags, telemetry and telecommand equipment, and spread spectrum devices including wireless local area network equipment in spectrum adjacent to the 2.3 GHz spectrum licence band.

(2) The general public are typically licensed to operate these devices on a no-interference, no-protection basis. The devices operated under class licences tend to be mobile and ubiquitous making coordination problematic. Despite this, ACMA gives consideration to the potential interference affects on devices operated under these class licences caused by the introduction of new services or systems.

6.2 Protection requirements

Compliance with the specified in-band and out-of-band emission limits set out in the draft spectrum licence together with the siting of transmitters using good engineering practice will be accepted by ACMA as the provision of sufficient protection to minimise the potential for interference to devices operating under a class licence.

Schedule 1 Propagation models

(section 1.5)

1 Introduction

1.1 A number of propagation models have been developed to estimate the path loss between a transmitter and receiver. The choice of a particular propagation model will depend on a number of 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.

1.2 ITU-R Recommendation P.1144 gives a guide on the applications of the various propagation methods developed internationally by the ITU. Table 1 is an extract of the 1995 issue of ITU-R Recommendation P.1144 and provides a summary of the ITU propagation models relevant to services operating in the 2.3 GHz spectrum licence band. The models provide an estimation of either path loss or received field strength.

1.3 Most models include statistical evaluation of path loss or signal levels expected at certain percentages of locations for certain percentages of times. Some propagation models produce a result that represents the median signal level. The median signal level corresponds to a level that is exceeded 50% of the time in 50% of locations.

1.4 The median level is useful for estimating coverage. It is not suitable for interference calculations as interference for 50% of the time is generally considered unacceptable.

1.5 Therefore, care must be taken when using propagation models to predict interference levels to ensure that the result represents the signal level exceeded for a sufficiently small percentage of locations for a sufficiently low percentage of time, as appropriate for the circumstance. Median signal levels may be converted to other time and location percentages (eg 1% of the time and 10% of locations) by applying appropriate correction factors.

2 Propagation models

2.1 Propagation models can be classified into two different types — point-to-point and point-to-area.

3 Point-to-point models

3.1 Point-to-point models allow the prediction of path loss between a fixed transmitter and a fixed receiver. Two of the main propagation modes are:

(a) free space loss (line-of-sight); and

(b) diffraction loss, including smooth Earth diffraction and diffraction over obstacles and irregular terrain (knife-edge diffraction).

3.2 The free space loss propagation model is usually used where paths are line-of-sight and there are no obstructions within the first Fresnel zone for a given k-factor. This usually occurs with services located on high sites such as mountain tops, towers or buildings.

3.3 The diffraction loss propagation model is typically used where paths are obstructed by the Earth's curvature or terrain. The model gives a loss due to diffraction which must be added to the free space loss to give the total path loss.

3.4 A plot of the terrain profile is usually generated to determine which propagation model is most appropriate to a particular propagation path.

3.5 Information on how to determine propagation losses due to free space and diffraction over a spherical Earth, obstacles and irregular terrain can be found in Recommendation ITU-R P.526. Additional propagation loss due to effects such as tropospheric scatter, ducting, layer reflections and clutter can be found in Recommendation ITU-R P.452. The ITU has available a computer program to predict propagation loss in accordance with Recommendation ITU-R P.452.

4 Point-to-area models

4.1 Point-to-area models provide for the prediction of field strength levels in a geographic area from a base station transmitter. They are useful for estimating the coverage area of base stations in which receivers are to be protected from interference and to estimate interference to mobile receivers from other services. They are statistical in nature and usually based on the statistical analysis of measured data, taking into account factors such as Raleigh fading, shadowing and clutter loss.

4.2 Recommendation ITU-R P.529 provides guidance on the prediction of field strength for the land mobile service in the VHF and UHF bands. It contains curves for predicting median field strengths for 50% of locations for 50% of the time under average conditions. It also provides various correction factors, which can be used to refine the average predictions to take account of the terrain.

4.3 The curves are based on measurements made by Okamura and Hata in Japan. They are normally applied to mobile applications where the base station antenna is high and the mobile antenna is low (typically 1.5 metres above ground). Correction factors can be applied to the curves to accommodate other percentages of time and percentages of locations.

4.4 Other point-to-area models such as those developed by Okamura and Hata or Longley-Rice may also be appropriate as they include factors for clutter (buildings, trees etc) with low receive antenna heights. The Hata model also makes allowance for the difference in path losses between urban, suburban and rural areas. The Hata model was derived from experiments measuring signal levels of land mobile services in Japan, so care must be taken when applying it to Australian environments.

4.5 It should be noted that there are significant restrictions in the range of applicability of the Hata model as it is:

(a) limited to propagation paths up to 20 km in length; and

(b) limited in the range of valid antenna heights.

4.6 The lower antenna must be in the range 1 to 10 m and the high antenna must be in the range 30 to 200 m. It should be noted that the Hata model does not take into account specific path variations, so the antenna heights used should be the effective height above the surrounding terrain and not solely the antenna height above ground level.

4.7 The Modified Hata model (ITU-R Report 567-4) extends the path length range to 100 km.

TABLE 1 ITU-R Propagation Prediction Methods

Method	Application	Type	Output	Frequency	Distance	time (%)	location (%)	Terminal height	Input data
Rec. ITU-R P.370	Broadcasting	Point-to-area	Field strength	30 MHz to 1000 MHz	10 to 1 000 km	1, 5, 10, 50	1 to 99	*Tx:* effective height from less than 0 m to greater than 1 200 m *Rx:* 1.5 to 40 m	Distance Tx antenna height Frequency Percentage time Rx antenna height Terrain clearance angle Terrain irregularity Percentage locations
Rec. ITU-R P.452	Services employing stations on the surface of the Earth; interference and coordination	Point-to-point	Path loss	700 MHz to 30 GHz	Not specified but up to and beyond the radio horizon	0.001 to 50 Average year and worst month	Not applicable	No limits specified	Path profile data Frequency Percentage time Tx antenna height Rx antenna height Latitude and longitude of Tx Latitude and longitude of Rx Meteorological data
Rec. ITU-R P.526	Fixed	Point-to-point	Field strength	Not specified but generally >30 MHz	Not specified but up to and beyond the radio horizon	Not specified but dependent on k-factor chosen	Not applicable	No limits specified	Path profile data Frequency Tx antenna height Rx antenna height Latitude and longitude of Tx Latitude and longitude of Rx Meteorological data
Rec. ITU-R P.528	Aeronautical mobile	Point-to-area	Path loss	125 MHz to 15 GHz	0 to 1 800 km (For aeronautical applications 0 km horizontal distance does not mean 0 km path length)	5, 50, 95	Not applicable	H1: 15 m to 20 km H2: 1 to 20 km	Distance Transmitter height Frequency Receiver height Percentage time

Method	Application	Type	Output	Frequency	Distance	time (%)	location (%)	Terminal height	Input data
Rec. ITU-R P.529	Land mobile	Point-to-area	Field strength	30 MHz to 3 GHz (Limited application above 1.5 GHz)	VHF: 10 to 600 km UHF: 1 to 100 km	VHF: 1, 10, 50 UHF: 50	Unspecified	Base: 20 m to 1km Mobile: 1 to 10 m	Distance Base antenna height Frequency Mobile antenna height Percentage time Ground cover
Rec. ITU-R P.530	Line-of-sight Fixed links	Point-to-point Line-of-sight	Path loss Diversity improvement (clear air conditions) XPD	Approximately 150 MHz to 40 GHz	Up to 200 km	All percentages of time in clear-air conditions; 1 to 0.001 in precipitation conditions	Not applicable	High enough to ensure specified path clearance	Distance Transmitter height Frequency Receiver height Percentage time Path obstruction data Climate data
Rec. ITU-R P.617	Trans-horizon fixed links	Point-to-point	Path loss	>30 MHz	100 to 1 000 km	20, 50, 90, 99 and 99.9	Not applicable	No limits specified	Frequency Tx antenna gain Rx antenna gain Path geometry
Rec. ITU-R P.618	Fixed satellite	Point-to-point	Path loss Diversity gain and (for precipitation condition) XPD	1 to 30 GHz	Any practical orbit height	0.001, 0.01, 0.1, and 1 (for both rain attenuation and XPD)	Not applicable	No limit	Meteorological data Frequency Elevation angle Height of Earth station Separation and angle between earth station sites (for diversity gain) Antenna diameter and efficiency (for scintillation) Polarization angle (for XPD)
Rec. ITU-R P.620	Earth station frequency coordination	Coordination distance	Distance of which the required propagation loss is achieved	1 to 40 GHz	100 to 1 200 km	0.001 to 1	Not applicable	No limits specified	Frequency Percentage of time Earth-station elevation angle

Method	Application	Type	Output	Frequency	Distance	time (%)	location (%)	Terminal height	Input data
Rec. ITU-R P.681	Land mobile satellite	Point-to-point	Path fading Fade duration Non-fade duration	0.8 to 3 GHz	Any practical orbit height	Not applicable Percentage of distance travelled 1 to 20	Not applicable	No limit	Frequency Elevation angle Percentage of distance travelled Approximate level of optical shadowing
Rec. ITU-R P.1146	Land mobile Broadcasting	Point-to-area	Field strength	1 to 3 GHz	1 to 500 km	1 to 99	1 to 99	Tx: ε = 1 m Rx: 1 to 30 m	Distance Frequency Tx antenna height Rx antenna height Percentage time Percentage location Terrain information
Rec. ITU-R P.1546	Terrestrial services	Point-to-area	Field strength	30 to 3000 MHz	1 to 1000 km	1 to 50	1 to 99	Tx (Base): Higher than surrounding clutter. Rx (Mobile): >1 m If adjacent to sea than >3 m	Distance Frequency Tx antenna height Rx antenna height Percentage time Percentage location Terrain clearance

Note

1. All legislative instruments and compilations are registered on the Federal Register of Legislative Instruments kept under the *Legislative Instruments Act 2003*. See http://www.frli.gov.au.